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NOT TO BE TAKEN FROM THIS ROOM

A DECISION SUPPORT SYSTEM FOR QUALITY CONTROL

by

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ABSTRACT

The important role of Quality Control in the economic growth of Turkey has become a well-known fact, especially in the last few years when Turkey has increased her efforts for expanding the exports.

However, Quality Control is not understood and utilized effectively as a management tool in most of the Turkish industrial companies. There exists a large gap between the practical applications and the theoretical developments in statistical quality control techniques, due to a lack of understanding of QC by managers.

In this study, Decision Support Systems (DSS) are proposed as a tool that would be helpful in filling this gap, by leading the managers towards the use of scientific management approach in making decisions related to quality improvement.

Quality Control activities are conducted through various decisions ranging from short-term to long-term taken at different levels of management. In this study, only one of these decisions is taken into consideration and it is aimed to give support to one of the basic activities of QC, namely the feedback mechanism between production and management.

Thus, a decision support system is designed to aid the management in fighting with the chronic quality problems, in a way to provide a set of capabilities expected from a DSS, in general.

This decision support system which will be called QCDSS, is an interactive computer-based system which helps the decision-maker in the identification of vital chronic quality problems, and in the evaluation of possible precautions that can be taken to give remedy.

QCDSS combines flexible, ad hoc data analysis capabilities with some models. This integration is achieved through a user-friendly dialog component. The problem identification phase of the decision is supported by a systematic Pareto analysis model which will be called "Failure Analysis Module" while a Monte-Carlo simulation model embedded in the "Revision of the Inspection Plan Module" is utilized to support the alternative evaluation phase.

QCDSS is developed for a light bulb manufacturing company where production is continuous and controls are by attributes.

ÖZET

Özellikle son yıllarda ihracatı artırma gayretlerinin yoğunlaşmasıyla birlikte, Kalite Kontrolun Türk ekonomisinin gelişmesindeki önemi herkesçe bilinen bir gerçek haline gelmiştir.

Ancak, Kalite Kontrol Türk Sanayiinin büyük bir bölümünde bir yönetim aracı olarak anlaşılmamakta ve etkin bir şekilde kullanılmamaktadır. İstatistiksel kalite kontrol teknikleri üzerindeki teorik çalışmalarla bunların sanayideki uygulamaları arasında, Kalite Kontrolun yöneticileri tarafından yeterince kavranılmamış olmasından ileri gelen bir uçurum vardır.

Bu çalışmada, Karar Destek Sistemleri (KDS) yöneticilerin kalitenin iyileştirilmesiyle ilgili kararları almada bilimsel yönetim yaklaşımını kullanmalarını sağlayacak ve dolayısıyla bu uçurumu doldurmaya yarayabilecek bir araç olarak önerilmektedir.

Kalite Kontrol etkinlikleri yönetim şemasının çeşitli kademelerinde alınan kısadan uzun vadeye birçok kararlar yoluyla yönetilmektedir. Bu çalışmada, bu kararlardan yalnızca biri ele alınmış, Kalite Kontrolun ana etkinliklerinden biri olan üretim ve yönetim arasındaki geribesleme mekanizmasının desteklenmesi amaçlanmıştır.

Bu amaçla, kronik kalite problemlerinin çözümüne yönelik bir karar destek sistemi, genel anlamda bir KDS'den beklenebilecek bir dizi özellik dikkate alınarak geliştirilmiştir.

QCDSS adı verilen bu karar destek sistemi, önemli kronik kalite sorunlarının belirlenmesi ve bunların giderilmesi için alınabilecek önlemlerin değerlendirilmesi aşamalarında karar vericiye yardım eden etkileşimli bir bilgisayar sistemidir.

QCDSS karar vericinin istemine ve problemin özelliklerine uyarlanabilir veri analizi olanaklarıyla bazı modelleri, kolay kullanımlı diyalog öğesinin yardımıyla kaynaştırmaktadır. Kararın problemin belirlenmesi aşaması "Hata Analizi" adı verilen sistematik bir Pareto analizi modeli tarafından desteklenirken, seçeneklerin değerlendirilmesi aşamasını "Kontrol Planının Yenilenmesi Modülü"nde yer alan bir Monte-Carlo benzetim modeli desteklemektedir.

QCDSS, sürekli üretim ve nitelik kontrollerinin geçerli olduğu, ampul üretimi yapan bir fabrikada uygulanabilecek biçimde geliştirilmiştir.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	iii
ABSTRACT	iv
ÖZET	v
LIST OF FIGURES	viii
LIST OF TABLES	x
I. INTRODUCTION	1
1.1. QUALITY CONTROL APPLICATION IN TURKEY	1
1.1.1. Importance of Quality Control in Turkey	1
1.1.2. Practice and Management of QC in Turkish Firms	4
1.2. DECISION SUPPORT SYSTEMS	7
1.2.1. A Formal Definition of DSS -Is it Possible?	7
1.2.2. Information Systems and DSS	10
1.2.3. A Set of Capabilities Expected From a DSS	12
1.2.4. Development Approach for DSS	16
1.2.5. Components of DSS	18
1.3. NEED FOR A DSS CAPABILITY FOR QC	24
II. A DECISION SUPPORT SYSTEM FOR QUALITY CONTROL	27
2.1. THE SPECIFIC DECISION	27
2.2. DECISION STEPS	30
2.2.1. Problem Identification	31
2.2.2. Problem Investigation	31
2.2.3. Design of Alternatives	31
2.2.4. Evaluation of Alternatives	32
2.2.5. The Choice	32
2.3. THE POSITION OF THE SPECIFIC DSS IN THE OVERALL DECISION MECHANISM	32

Page

2.4. THE POSITION OF THE SPECIFIC DSS IN THE INFORMATION FLOW 33

III. AN APPLICATION IN A LIGHT BULB FACTORY 37

3.1. CURRENT QUALITY CONTROL APPLICATION IN LIGHT BULB MANUFACTURING 37

3.1.1. In-Process Inspection 41

3.1.2. Finished Product Inspection 42

3.1.3. Laboratory Tests 45

3.2. THE PROPOSED SYSTEM: QCDSS 46

3.2.1. Data Files of QCDSS 48

3.2.2. Failure Analysis Module 55

3.2.3. Revision of the Inspection Plan Module 60

3.3. USER'S VIEW OF QCDSS THROUGH A SCENARIO 69

IV. CONCLUSIONS AND EXTENSIONS 77

4.1. IMPORTANT CHARACTERISTICS OF QCDSS 77

4.2. EVALUATION OF QCDSS 79

4.3. POSSIBLE EXTENSIONS TO QCDSS 81

APPENDIX A. TABLES AVAILABLE IN FAILURE ANALYSIS 83

APPENDIX B. NOTES ON PROGRAMMING ASPECTS 91

APPENDIX C. LISTING OF THE COMPUTER PROGRAM FOR FAILURE ANALYSIS MODULE 92

APPENDIX D. LISTING OF THE COMPUTER PROGRAM FOR REVISION OF THE CONTROL PLAN MODULE 117

APPENDIX E. LISTING OF THE COMPUTER PROGRAM FOR DATA INPUT MODULE 134

BIBLIOGRAPHY 147

LIST OF FIGURES

		Page
FIGURE 1.1	Data-oriented versus Model-oriented DSS types	19
FIGURE 2.1	Position of QCDSS in the Decision Mechanism and in the Information Flow	35
FIGURE 3.1	Incandescent Light Bulb Manufacture	38
FIGURE 3.2	Fluorescent Lamp Manufacture	39
FIGURE 3.3	Mercury Vapor Lamp Manufacture	40
FIGURE 3.4	Main defective types produced at each operation	43
FIGURE 3.5	Control Stations in Incardescent Lamp Production	44
FIGURE 3.6	Components of QCDSS	47
FIGURE 3.7	Contents of a record in In-process Inspection Data File	50
FIGURE 3.8	Contents of a record in Defect Types File	54
FIGURE 3.9	Contents of a record in Inspection Plans File	54
FIGURE 3.10	Failure Analysis Module as the User sees it	56
FIGURE 3.11	Analysis Level Menu	57
FIGURE 3.12	Determination of the Analysis Period	59
FIGURE 3.13	Monte-Carlo Simulation Model used in evaluating the alternatives	61
FIGURE 3.14	The Revision of the Inspection Plan Module as the User sees it	62
FIGURE 3.15	The Model of the Inspection Procedure	63

LIST OF TABLES

		Page
TABLE 1.1	Foreign Trade Structure of Turkey	2
TABLE 1.2	Characteristics of Particular Decision Support System Types	20
TABLE 2.1	QC Activities Classified According to types of decisions and degree of decision structure	34
TABLE 3.1	Table of seriousness Classes for defect types	45
TABLE 3.2	Table for the Overall Period with respect to Machine groups for Mounting Control	71
TABLE 3.3	Table for the Overall Period with respect to Machine Groups for Finishing Control	71
TABLE 3.4	Time-series table with respect to Machine Groups for weekly defective percentages in Finishing control	72
TABLE 3.5	Time-series table with respect to Machine Groups for weekly cost weights in Finishing control	72
TABLE 3.6	Table for The First Five Defects for Finishing Control	74
TABLE 3.7	Time-series Table for defective percentages for the last six weeks	75
TABLE 3.8	Time-series Table for cost weights for the last six weeks	75

I. INTRODUCTION

In this chapter, it is aimed to underline the fact that quality control activities have an important role in the Turkish economy, and they need to be improved through scientific management approach. DSS is suggested as a tool for improving the quality level of the Turkish industrial products.

For this purpose, after a brief discussion of the Quality Control application in Turkey, the concept of DSS will be introduced and benefits possible from a DSS in QC will be considered.

1.1. QUALITY CONTROL APPLICATION IN TURKEY

1.1.1. Importance of Quality Control in Turkey

One of the most important bottlenecks in the Turkish economy is the deficit in foreign payment balance which follows an increasing trend.

Taking the import-export structure of our country into consideration (See Table 1.1) it is seen that the growth of the Turkish economy highly depends on the ability of increasing foreign payment opportunities. The most healthy

FOREIGN TRADE INDICES

Years	Exports Price TL.	Exports Price $	Exports Quantity	Imports Price TL.	Imports Price $	Imports Quantity	Trade limits (1)	Trade limits (2)
1974	137.6	136.0	82.0	145.2	147.9	122.3	94.6	92.0
1975	134.4	128.3	79.2	168.0	165.1	139.4	80.0	77.7
1976	153.0	133.3	104.7	183.9	167.0	143.7	81.0	79.8
1977	191.5	146.2	84.8	233.1	184.1	149.9	82.2	79.4
1978	274.1	154.9	106.9	361.0	209.8	92.2	75.9	73.8
1979	437.5	182.4	85.5	605.3	247.5	84.4	72.3	73.7
1980	1.198.6	215.8	84.8	2.055.5	379.2	96.8	58.1	56.9
1981	1.571.9	191.3	136.7	2.879.7	367.3	116.8	54.6	52.1
1982	2.129.7	178.9	165.1	4.168.9	360.3	119.8	51.1	49.7
1982 I quartor	1.632.0	178.0	165.9	3.616.8	359.8	107.0	50.7	49.5
1983 I quartor	2.337.5	166.2	159.2	5.147.2	374.7	125.9	45.4	44.4

IMPORTS

(000 Us dolars)

Months	1981	1982	Change %	1983	Change %
January	781.934	607.965	—22.2	739.713	21.7
February	843.742	667.539	—20.9	749.974	12.3
March	577.547	684.848	1.1	859.522	25.5
April	652.461	759.560	16.4	665.214	—12.4
May	759.863	768.684	1.2	729.856	— 5.1
June	669.113	734.666	9.8	724.526	— 1.4
July	777.099	678.238	—12.7	629.599	— 7.2
August	663.039	654.002	— 1.4	764.450	16.9
September	689.036	672.285	— 2.4	682.994	5.9
October	657.245	747.517	13.7	729.058	6.0
November	800.120	782.683	— 2.2	825.465	5.0
December	962.146	1.084.670	12.7	1.090.084	0.5
Total	8.933.374	8.842.665	— 1.0	9.235.001	4.4

EXPORTS

(000 us dollars)

Months	1981	1982	Change %	1983	Change %
January	410.642	446.114	8.6	478.147	7.2
February	306.580	410.151	38.8	403.406	— 1.6
March	304.184	447.300	46.1	476.500	6.5
April	316.076	402.100	27.2	483.529	20.2
May	294.350	414.468	40.8	425.452	2.6
June	325.349	419.605	29.0	406.877	— 3.0
July	315.764	412.678	30.7	351.810	—14.7
September	335.812	408.357	21.6	422.502	3.4
August	399.976	456.416	14.1	459.764	0.7
October	436.841	560.031	15.1	566.184	1.1
November	552.264	604.731	9.5	579.668	— 4.6
December	655.297	764.025	16.6	674.039	—11.8
TOTAL	4.702.935	5.745.975	22.2	5.727.833	— 0.3

Source : SIS

TABLE 1.1- Foreign Trade Structure of Turkey

and confident way to accomplish this is increasing the export income parallel to the increase in the import expenditure. Various short and long term precautions should be taken to expand the export, and thus, decrease the pressure on foreign payment balance.

One of the main precautions to be taken in the long run is changing the structure of exports in Turkey, which is highly dependent on certain agricultural products. This change in export structure can be accomplished by continuously increasing the share of industrial products in total export income.

This improvement can be achieved in the long run by an export-oriented, rational, coordinated industrialization policy.

Main concerns of such a policy should be optimum resource allocation, standardization and product quality.

As a matter of fact, in many studies on the subject it is stated that one of the main reasons for the low progress rate in export is the low quality level of the exported goods and the lack of standardization(1,2,3,4).

Developing countries generally encounter harsh competition conditions in international markets. Therefore, quality level and cost play a crucial role in the export of industrial products.

To achieve competitive levels on quality and unit cost, industrial organizations should apply scientific management rules. Production planning, process cost analysis and statistical quality control during all phases of production should be effectively used as management tools.

1.1.2. Practice and Management of QC in Turkish Firms

Although Quality Control has such an important role in economic growth of Turkey, the practice of QC in industry is quite limited and insufficient.

Apart from a few companies which have organized QC systems, what is done usually is a simple grading of the final product for the purpose of determining the sales price.

This lack of efficient QC systems arise from the absense of a number of important features of modern QC application. In general, the following shortcomings account for the insufficient practice:

(i) Having no predefined quality objectives;
(ii) Insufficient data on
- technology
- labor
- material
- cost
- field-service, etc.;

(iii) Not having any preset acceptance criteria;
(iv) Lack of a proper reporting system;
(v) Low use of statistical QC;
(vi) Absence of research and development activities,
(vii) Poor calibration or lack of equipment;
(viii) Unsatisfactory management-labor relationships;
(ix) Absence of training programs;
(x) Insufficient coordination and information flow among various departments;
(xi) Lack of part standardization.

It is not a surprise that efficient decisions on quality related problems cannot be made in environments where

a few of the above shortcomings co-exist.

The value of QC as a management tool and the impact of quality-cost reduction on profits is not well understood(5).

Quality costs (internal and external failure costs, appraisal costs and prevention costs) are not quantified and the net gain that would be brought by quality planning is not known.

The belief that QC only judges the level of quality in a certain product and it does not add value to that product cause the production and management underutilize and underrate QC efforts.

The "total quality control" concept is rarely applied. Thus, the chance of "catching the defective at its source" is missed and high losses in material and labor are sufferred.

Furthermore, the real purpose of inspection is sometimes missed, resulting in the substitution of a "inspect it better" attitude in place of "make it better"(6).

In many cases, it is seen that, even though quality data of considerable volume and sophistication is produced through the use of some highly technical and expensive equipment, this information is rarely used to control the quality of the production. Often, the reason is that the information feedback to the production line is too slow to be of use-the product leaves the factory before the analyses reach the production engineers.

Many of there problems encountered in the use of QC as a management tool, are not typical for our country, only. A recent survey in the United Kingdom chemical manufacturing

industry revealed surprisingly low use of statistical quality control techniques because of lack of understanding(7). The main reasons for the non-adoption of statistical methods identified in this study will be given here since the situation is very similar to that in Turkey.

In most of the companies who did not use statistical quality control (SQC),

(i) they were unaware of SQC techniques,
(ii) they were aware of SQC techniques, but never tried them,
(iii) there was a lack of understanding of SQC techniques.

Most of the QC managers revealed their beliefs that "SQC would involve a great deal of work", "it was much quicker and reliable to use the judgement of experienced individuals", "the theory would not work in real life", "the production managers were reluctant to get involved in statistics and numerical analysis".

It is more than 50 years since Shewhart (1931) introduced the concept of SQC. Since then, many extensions and modifications have been made, offering a wide range of effective techniques. There exists, however, a large gap between the practical applications of and the academic researches in the statistical techniques of quality control. Considerable advances in the basic knowledge and understanding of QC by managers are required before advantage can be taken of these developments.

1.2. DECISION SUPPORT SYSTEMS

Together with the rapid development in computer technology, such as personal computers, computer networks, large data bases, color graphics and computer-based models, there is an increasing interest in the use of computers to support decision making. Such uses are being called Decision Support Systems (DSS).

In this section, it will be discussed what is really meant by the term "Decision Support Systems". The aim and main characteristics of DSS, the differences between DSS and traditional TPS (Transaction Processing Systems) and MIS (Management Information Systems), the framework of a DSS and the design approach are further issues to be discussed through a literature survey.

1.2.1. A Formal Definition of DSS-Is It Possible?

The concepts involved in DSS were first presented by Micheal S.Scott Morton under the term "Management Decision Systems", in the early 1970's.

He explored the possibilities for improvement in management problem solving through the use of a visual display device. His understanding of such a system can be found in the following paragraphs (p.6 of (8)):

"Observation of managers at work indicates that they spend a large portion of their time in verbal communication with others. This is also true within a decision-making cycle; that is, the process of defining and solving problems is often accomplished by "talking" the problem through to solution.

The internal and very informal "model", or set of guidelines, that each manager has in his mind is used by him as a frame of reference against which to pass the facts that he perceives in a conversation. From this, and other sources he develops his definition of a problem-that is, a difference between what his internal "model" says is expected and what he actually perceives. Similarly, he has informal models or processes that he uses to solve problems as he perceives them. In both cases the problem finding and problem solving are intuitive judgemental kinds of processes.

It seems desirable to leave the manager with this freedom but also help him build as firm a base from the facts as possible-and only then have him apply his judgement to this base. This is done by providing him with flexible access to the data and by making available the use of relevant formal models to process and filter the data for him. There is a rapidly expanding technology in the field of Operations Research and mathematical models. This technology can be brought to bear on problems and made to support the manager's decision. The computer technology and the modelling technology will allow this, and it is clear that this technology can be used by normal line managers with considerable benefit".

Connecting the keywords in these paragraphs and in later works which extend these ideas, DSS can be defined as, interactive computer-based systems that help decision makers utilize data and models to solve unstructured problems.

However, as expressed by Carlson and Sprague(9), this definition is quite restrictive and a few actual systems can satisfy it completely.

Furthermore the term "unstructured" in this definition, caused a confusion which raised a debate in DSS literature.

Using Simon's(10) definition, decisions can be classified as structured (programmable) or unstructured (non-programmable) depending on whether or not the decision-making process can be described in detail before making the decision. A decision may be unstructured because of novelty, time-constraints, lack of knowledge, large search-space, multi-dimensionality, complex interrelationships, requirement for managerial judgement and nonquantifiable data, dynamic environment, or other reasons.

However, a problem can only be structured "with regard to" a particular decision maker, or a well-defined set of decision makers(11). In other words, the concept of "structure" in decision making is heavily dependent on the cognitive style and approach to problem solving of the decision maker. Thus, it is both misleading and incorrect to speak of "structured" or "programmed" problems in the general case.

As a second attempt for a definition, the term itself, whose origin is straight forward enough, can be used in the way Moore and Chang suggest (p.8 in(11)):

"1- Decision-emphasises the primary focus on decision making in problem situations rather than simply information retrieval, processing or reporting;

2- Support-clarifies the computer's role in aiding rather than replacing the decision-maker, thus including those decision situations with sufficient "structure" to permit computer support, but in which managerial judgement is still an essential element;

3- System-highlights the integrated nature of the overall approach, suggesting a wider context of man, machine and decision environment".

This time, however, the definition is too broad.

So, here, instead of a formal definition, the "characteristic" approach used by Carlson and Sprague(9) will be used, to give an understanding of DSS.

The following characteristics are the capabilities which are required to accomplish the objectives that DSS are designed to accomplish:

(i) They tend to be aimed at less well-structured, underspecified problems that upper-level managers typically face. Here, the concept of "structuredness with regard to" a particular decision-maker will be used.

(ii) They attempt to combine the use of models or analytic techniques with traditional data access and retreival functions.

(iii) They specifically focus on features that make them easy to use by noncomputer people in an interactive mode.

(iv) They emphasize flexibility and adaptibility to accommodate changes in the environment and in the decision making approach of the user.

In this study, these guidelines will be used to distinguish DSS.

1.2.2. Information Systems and DSS

The next issue discussed in literature is the role of DSS in the overall context of information systems.

In fact the definitions given in the previous section make it clear that DSS is not an outgrowth of TPS or MIS.

However, because of the confusion caused by some highly data-oriented applications of DSS, DSS school of thought had some trouble in distinguishing its work from previous efforts in MIS development.

As a result, an attempt to draw a sharp distinction between MIS and DSS came up in the DSS literature.

Although such a rigid classification does not seem tenable, there are some subtle but significant distinctions between DSS and traditional TPS and MIS approaches.

The characterization given by Moore and Chang will be used in this study to distinguish between them (p.9 of (11)):

"1- Transaction Processing System (TPS)-Pure data processing programs for gathering, updating and posting information according to pre-defined procedures. Examples include a basic payroll system or an order processing system;

2- Management Information System (MIS)-A system with pre-defined aggregation and reporting capabilities, often built upon TPS. Examples are a payroll system with managerial reports, such as a labor distribution summary;

3- Decision Support System (DSS)-An extensible system with intrinsic capability to support ad hoc data analysis and reduction as well as decision modelling activities.

From a descriptive standpoint, TPS are frequently devoted to routine data processing tasks, involving high degree of formality, timeliness, accuracy and efficiency in

the processing of comparatively large volumes of data. MIS are often "report-oriented" in the sense that data is extracted and summarized into pre-defined formats, often on a periodic basis, for purposes of managerial review in reporting exceptions, deviations from standards, and historical trends. DSS subsume portions of an MIS system; especially the summarization and extraction capabilities, but the procedures for effecting this are more loosely defined, thereby permitting the user to select on an ad hoc basis the frequency and to a limited extent, the content of reports. The key notion is that the usage of DSS by the user is, within limits, not pre-specified and is aperiodic in contrast to MIS usage".

This "key notion" is believed to be essential in distinguishing DSS from MIS.

1.2.3. A Set of Capabilities Expected From a DSS

A primary question still remains: What are the capabilities that a good DSS should possess?

This can be analyzed through some performance objectives. The performance objectives defined by Carlson and Sprague(9) will be reviewed here. But, it should be noted that no specific DSS will be required to satisfy all six of the performance measures stated here, since any specific DSS will be very much dependent on the task, the organizational environment and the decision-maker(s) involved. However, as a group, the following objectives represent a set of capabilities that determine the value of the DSS concept from the manager/user point of view:

(1) A DSS should support semi-structured and unstructured decisions as well as structured ones.

Gorry and Scott Morton(2) claimed that most of the computer support that existed by 1970's was for structured decisions, that some work was under way for supporting semi-structured decisions, but that unstructured decisions were completely left out. They argued that, it is the semi-structured and unstructured decisions that are of greatest concern to decision makers.

However, it should be kept in mind that the concept of "structure" in decision-making is heavily dependent on the cognitive style and approach to problem solving of the decision-maker.

(2) A DSS should provide support for users at all levels, assisting in integration between the levels whenever appropriate.

Following Anthony(13) decision levels can be classified as:

(i) Strategic Planning: Decisions related to setting policies, choosing objectives and selecting resources.

(ii) Management Control: Decisions related to assuring effectiveness in acquisition and use of resources.

(iii) Operational Control: Decisions related to assuring effectiveness in performing operations.

(iv) Operational Performance: Decisions that are made in performing the operations.

(3) A DSS should support the communication between decision makers so as to support interdependent decision - making.

Hackathorn and Keen(14) define three decision types:

(i) Independent: A decision-maker has full responsibility and authority to make a complete implementable decision.

(ii) Sequential interdependent: A decision-maker makes part of a decision which is passed on to someone else.

(iii) Pooled interdependent: The decision must result from negotiation and interaction among decision-makers.

(4) DSS should support all phases of the decision making process.

A popular model of decision-making with three steps is given by Simon(10):

(i) Intelligence: Searching the environment for conditions calling for decisions. Raw data are obtained, processed and examined for clues that may identify problems.

(ii) Design: Inventing, developing and analyzing possible courses of action. This involves processes to understand the problem, generate solutions and test solutions for feasibility.

(iii) Choice: Selecting a particular course of action from those available.

Implementation phase can be added to this sequence as the fourth phase.

The cycle of phases, however, is more complex than the sequence suggests. At any given level, subproblems that in turn have their intelligence, design and choice phases can be encountered. In this structure it can be seen that MIS and TPS have their contribution in intelligence phase, whereas MS/OR contribute in choice phase. By adding support at design and implementation phases, DSS completes and integrates these decision phases.

(5) A DSS should support a variety of decision-making processes but not be dependent on anyone.

There is no universally accepted model of decision-making process. Simon's model is only one categorization and agreat variety of decision-making processes can be found in studies of decision-making.

Furthermore, a specific decision may be of a different type, in different organizations, at different times or for different decision-makers.

In fact, there has been some work on cognitive styles to drive operational guidelines for DSS design, i.e. regression models derived from a manager's past behavior to serve as a basis for future managerial decisions(15). However, this approach neglects the dynamic nature of the decision environment. If a DSS is designed for a specific type of decision and a specific decision-maker any change in them requires a change in the DSS to accomodate new conditions and leads to increased cost.

The effort should be toward creating a DSS that is flexible, friendly and provides a variety of options, so that a priori determination of the user's style as a basis for identifying the most appropriate design becomes irrelevant(16).

In short, DSS should be process independent and user-driven (or controlled). The term "user controlled" is used in the sense that the decision-maker is allowed to enter and use the DSS at any point in the decision process. Process flexibility can be obtained by reversing (inverting) model functions, i.e., treating decision variables as both input and output variables(11).

(6) A DSS should be easy to use.

It should be kept in mind that the aim is to help the decision-maker who is often a non-computer person.

1.2.4. The Development Approach for DSS

DSS require a unique approach to system analysis and design, because of a variety of reasons that may be encountered in a decision process(23):

(i) The designer or the user may be unable or unwilling to provide functional specifications and procedures, depending on the structure level of the task.

(ii) Users may not know what they want and the designers may not understand what they need or can accept; and initial system must be built to give users something concrete to react to.

(iii) User's concepts of the task or decision situation will be shaped by the DSS. The system stimulates learning and new insights, which in turn stimulate new uses and the need for new functions in the system.

(iv) The intended users of the system may handle the task in a variety of ways, or differ in the way they think to a degree that prevents standardization.

Items (i) and (iv) state that there is no well-defined process and the DSS should be process-independent. Item (iii) introduces the idea of an iterative design approach. Furthermore, while (iii) states that DSS shapes the user, (iv) equally suggests that the user shapes the DSS bringing forth the need for an adaptive design procedure. These issues will be discussed in the following paragraphs.

A user-oriented, process-independent design approach called ROMC is developed in works by Carlson and Sprague(9,24). The approach is based on defining a set of "Representations" that decision-makers use to conceptualize problems, "Operations" on those Representations, "Memory Aids" to support the use of Representations and Operations, and "Control Mechanisms" to apply different styles and skills. Different Representations, Operations, Memory Aids and Control Mechanisms may be required for all three decision phases of intelligence, design and choice.

Moore and Chang draw attention to the dynamic nature of the decision environments (p.11 of (11)):

"An important characteristic shared by all computer-based information systems is the need for periodic re-structuring, updating or expansion activities. For a variety of reasons-changing needs, earlier mis-specifications, revised context, change in capacity, newer technology, etc-all systems periodically under go such redirective activities. Without such activities, the system's usefulness would decline rapidly -hence, these changes are essentially mandatory. The periodicity of these operations is said to be shorther for DSS than other types of systems. In particular, a TPS might be rewritten every 3-5 years to synchronize with changes in the underlying operational hardware, and MIS expanded every 1-2 years to handle new requirements and regulations. A DSS could change

every few days or weeks, particularly during early phases of implementation and use".

Thus flexibility at moderate cost is a very important issue for DSS. This makes the traditional development life cycle approach which implicitly assumes a static decision environment inappropriate in DSS development. It is impractically time consuming and costly, and pre specification and consensus among clients concerning the desired system is difficult to achieve.

So, an iterative design procedure combining the typical steps of development life cycle approach (documentation of existing system,logical system design, physical system design, programming the new system and implementation), into a single step which is iteratively repeated, is suggested.

In this way, DSS will be built with short, rapid iterations, receiving feedback from users to ensure that development is proceeding correctly. DSS must be developed to permit quick and easy changes to accomodate the dynamic nature of the problem environment. These issues are discussed in detail in (9), (11) and (25).

User participation during development iterations of a DSS is an important factor which reduces the difficulties that may be encountered in implementation stages. Another direction of research in DSS literature, investigates the benefits of user involvement in system development(26,27,28, 29).

1.2.5. The Components of DSS

Alter(30) surveyed 56 DSS and divided them into two general categories: Data-oriented systems and model-oriented

systems. The data-oriented systems consist of systems for data retrieval, analysis and presentation, Both generalized and special purpose software are included in this category. The model-oriented systems provide accounting representational, optimization or suggestion models to help in decision-making (see Figure 1.1). The characteristics of these decision support system types are given on Table 1.2.

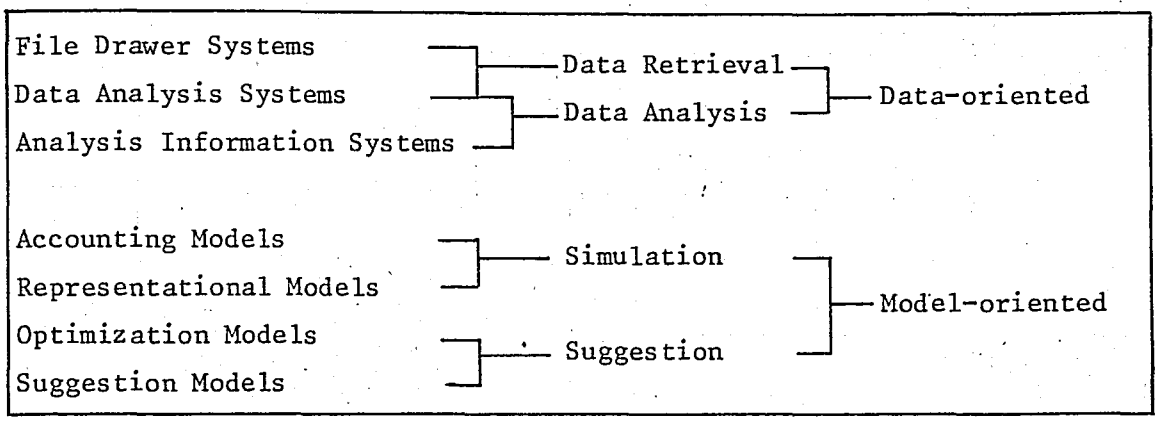

FIGURE 1.1- Data-oriented us Model-oriented DSS types(30)

There are many opinions on why data-oriented systems and model-oriented systems have not had much success in supporting decision-making, either ceasing to be used or being used for routine report generation rather than for direct support of decision makers. In general, the main problem seems to be a mismatch between the capabilities of these DSS and the requirements of the decision or decision-making.

This idea is viewed as follows in this study: The conceptual model is the problem as perceived by the decision-maker as a result of the intelligence activity. The modelling capabilities of DSS transform this conceptual model into a formal one. As the difference between the structure levels of the conceptual and formal models increases, the implementation of the solution generated by the formal model becomes harder,

CHARACTERISTICS	DECISION SUPPORT SYSTEM TYPES						
	A FILE DRAWER	B DATA ANALYSIS	C ANALYSIS INFORMATION	D ACCOUNTING	E REPRESEN-TATIONAL	F. OPTIMIZATION	G SUGGESTION
TYPE OF TASK	operational	operational or analysis	analysis	planning	planning	planning	operational
HANDS-ON USER	nonmanagerial line personnel	nonmanagerial line personnel or staff analyst	staff analyst	staff analyst or manager	staff analyst	staff or nonmanagerial line personnel	nonmanagerial line personnel
DECISION MAKER	nonmanagerial line personnel	nonmanagerial line personnel manager, or planner	manager or planner	manager, planner, or line personnel	manager	manager or nonmana-gerial line personnel	nonmanagerial line personnel
KEY ROLE	hands-on user	hands-on user	intermediary	intermediary, feeder	intermediary	intermediary	hands-on user
KEY USAGE PROBLEM	user motivation and training	can people figure out what to do with the system	how effective is the intermediary	integration into planning process	understanding	understanding	user motivation and under-standing
SYSTEM INITIATOR	managerial	entrepreneurial	entrepreneurial	user or managerial	entrepreneurial	mixed	mixed
KEY DESIGN AND IMPLEMENTA-TION PROBLEM	defining the data; pro-cedural changes	deciding how to use sys-tem; assess-ing impact on decisions	focusing usage and develop-ment; con-trol mix of projects	getting people to participate seriously in planning process	richness vs. understand-ability	richness vs. linearity and understand-ing	designing rules sensibly
KEY CHANGE ISSUE	changing in-formation sources and procedures	unfreezing job image and way of ap-proaching problems	using system as a vehicle for change	unfreezing procedures people are familiar with	unfreezing ways of approaching problems	unfreezing ways of approaching problems	unfreezing standard procedures; avoiding a fear reaction
KEY TECHNICAL PROBLEM	system crashes; re-trieval from large data base	flexible retrieval from broad data base; generality vs. power	flexible retrieval from broad data base	checking con-sistency of intention, meaning of numbers	modeling technology	modeling and solution technology	task modeling

TABLE 1.2 CHARACTERISTICS OF PARTICULAR DECISION SUPPORT SYSTEM TYPES

requiring persuation and additional transformation efforts. However, if the DSS supports the design and implementation activities as well as intelligence and choice activities by allowing the managerial judgements to be processed by the system and the user to gain insight to the problem through interactive supporting, the model rigidity will be reduced, the differences in the levels of structuredness of the conceptual and formal models will be reduced and the solution will be more readily applicable, reducing the implementation efforts. This can be achieved by attaching equal importance in the design of DSS to its three major components: The dialog, data and model subsystems.

(1) The Dialog Subsystem

The dialog subsystem consists of the user, the input and output media and the software. The dialog component meets the representation and control mechanism requirement of the DSS, by presenting DSS outputs to the users and collects user inputs to the DSS.

Dialog styles describe the nature of the interface between the system and the user. The choice of a particular style depends on the trade-offs on usability of the DSS versus the hardware and development costs(31).

(2) The Data Subsystem

The data subsystem consists of a data base and a data base management system, defined as a collection of programs used to create, maintain, access, update and protect one or more data bases.

The data base can be constructed using one of the data structures that can be found in data base literature, i.e., lists, tables, relations, hierarchies and networks(32).

The data base management system should provide(9):

(i) the ability to combine a variety of data sources through a data capture and extraction process;

(ii) the ability to add or delete data sources quickly and easily;

(iii) the ability to portray logical data structures in user terms so that the user understands what is available and can specify needed additions and deletions;

(iv) the ability to handle personal and unofficial data so that the user can experiment with alternatives based on personal judgement;

(v) the ability to manage this wide variety of data with a full range of data management function.

The main features of data management for DSS is discussed in(33).

(3) The Model Subsystem

DSS integrates analysis procedures and decision models into the data base and dialog capabilities. This full integration is necessary to support decision-making activities such as projection, deduction, creation and comparison of alternatives which require close interaction and rapid feedback between the decision-maker and the computer, with strong and flexible control mechanisms. To provide these capabilities, the modelling component of the DSS must have a "model base" developed in modular structure and a comprehensive set of model base management functions.

During the literature survey of this study a number of specific DSS were studied. This section will be concluded by mentioning a few of them, just for the purpose of giving examples. They are not claimed to be typical or representative for the DSS concept.

(i) A DSS for urban growth management developed by the Dept. of City and Regional Planning in Ohio State University(18).

The DSS is based on a multi-criteria framework that integrates several socio-economic, physical planning and urban design processes. The integrated framework is seen as consisting of an interaction of a data base, projections and forecasts, impact analyses, decision analysis, and political sensitivity analysis.

(ii) Geodata Analysis and Display System (GADS) developed by the IBM Research Lab in San Jose, California(19).

It is an interactive system with strong graphic display and "user-friendly" characteristics to enable non-computer people to access, display and analyze data that have geographic content and meaning. It was used for 17 specific decisions, such as police personnel allocation application, school district planning, etc.

(iii) An Interactive Media Decision Support System(20).

It is an interactive, terminal based DSS which manages a large data base and provides many models that aid the advertising decision maker in media planning decisions such as establishing a desired market, finding media which reach that market, and allocating advertising funds to these media.

(iv) A Model-Directed Information System for Management of the Federal Courts(21).

To satisfy the diverse information needs of federal courts a family of information management systems has been developed, based upon formal mathematical models of judical case processing embedded in interactive data base information systems for case tracking and case load management.

(v) A DSS for Ski Area Design(17).

Designing a ski area is based on a decision process with many feasible solutions involving a host of simple calculations, supported by expert judgements, and not subject to mathematical optimization. The issue of creating a process-flexible DSS has been considered in this study.

(vi) An Overall Interactive Computer-Based System for Petkim-Aliağa Complex(22).

This is an overall system design aiming to create an organizational and operational structure for efficient management of production activities in Petkim Aliağa Complex which is still in foundation phase.

1.3. NEED FOR A DSS CAPABILITY FOR QC

In Section 1.1.2. it was pointed that QC is not well understood as a management tool, and there is a lack of understanding of the statistical quality control techniques. Most of the managers prefered using their experience and judgements in solving the problems, because they cannot conceptualize formal models and the solutions generated by formal models can be difficult to implement.

Therefore, the first thing needed is a tool which helps filling this gap between the formal QC methods and the decision maker's understanding of them. Such a tool, should improve the decision-making process of the user by making him use scientific management approach to problems.

Furthermore, it should be friendly to the user. It should allow him use his experience and judgements on the subject in generating alternative solutions to the problem and in finding an "implementable" solution among them.

Such a support on decision making in QC, is possible through the use of a DSS, which satisfies the characteristics given by Carlson and Sprague(2):

(i) A DSS in QC supports decisions which are not well-defined in the minds of the decision makers. Since the concept of unstructuredness is subjective, a problem can only be structured "with regard to" a particular decision maker, or a well-defined set of decision-makers.

In our country, QC related decision problems can often be regarded as "unstructured" because the decision-makers do not have the habit of using scientific approach when trying to solve them.

(ii) A DSS in QC should combine the use of statistical, analytical or representational models with flexible data access and retrieval functions. This should be done in a way to allow the user to experiment with the QC system, to integrate his judgements in the solution procedure, and to learn about the system while doing these.

(iii) A DSS in QC should focus on features that makes it easy to use by non-computer people in an interactive mode.

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(iv) A DSS in QC should be flexible and adaptible to changes in the QC environment and in the decision-making approach of the user which is expected to improve through the use of the DSS.

In the following chapters of this study, a specific DSS designed for QC will be explained. In Chapter II the specific decision taken into consideration and the way it is supported by the "Quality Control Decision Support System (QCDSS)" will be discussed. In Chapter III, an application of QCDSS in a light-bulb factory will be described in detail. Lastly, in Chapter IV, some concluding remarks will be made, and some possible extensions to QCDSS will be mentioned.

II. A DECISION SUPPORT SYSTEM FOR QUALITY CONTROL

Quality control function in an industrial organization is carried on through various decisions ranging from short to long range taken at various levels of the management.

In this study, a specific class of them, decisions related to the remedy of chronic quality problems are taken into consideration.

In this chapter, these decisions and the DSS designed to support them will be discussed.

2.1. THE SPECIFIC DECISION

Quality activities held in a QC department are concerned with both sporadic and chronic quality problems.

A sporadic problem is a sudden adverse change in the quality performance, requiring remedy through restoring the standard performance(34). The inspection plan is utilized for this purpose-that is, to control production in all stages by measuring actual quality performance, comparing it with standard and acting on the difference.

A chronic problem, on the other hand, is a long standing adverse situation, requiring remedy through changing the existing system. Since ways to do better than the standard should be found, these problems are often difficult to solve. Each case having different characteristics, it is very hard for the decision maker(s) to state a general, structured solution procedure when confronting with the problem. All these difficulties make most of the industrial organizations accept chronic problems as inevitable. Furthermore, firefighting on sporadic problems may take continuing priority, although larger savings are possible on chronic problems.

The essential features of chronic problems that would make a DSS capability a valuable and necessary tool can be listed as follows:

(i) As explained above, the decision makers have a kind of intimidation for this kind of problems. Therefore, a supporting tool which encourage interest and efforts towards the solution of chronic problems, by making the user understand the underlying conditions in the production would be a great help. Since gaining insights for the general QC system as well as the problem is required, this support should offer a learning process, i.e., the ability of experimenting with the system. This feature can be handled by a DSS.

(ii) The problem can be identified through data analysis. But an MIS in traditional context is not sufficient in this case(3), because the problem is aperiodic in nature and the data analysis should be ad hoc. The problem should be "searched for", so instead of pre-formatted reports, reports of flexible content are required. This flexibility can be offered by a DSS.

(iii) The predictive and planning orientation of the problem necessitates some modeling capability in addition to data analysis capabilities. However, a classical optimization approach would be even more intimidating, especially because optimization models often cannot be conceptualized well enough by the decision makers (See Section 1.1.2 and Section 1.3).

On the other hand, the nature of the problem requires the use of some managerial judgement. Since the solution will impose a change in the system, a resistance to this change will come up in the implementation phase. So, in choosing the solution the problem should be judged with all its aspects: Financial, technological and social.

So a DSS capability which combines data, model and dialog capabilities is necessary (See Section 1.2.3). The necessity for a dialog component is inherent in all three of the issues discussed up to now.

(iv) Quality Control system as a decision environment is quite dynamic in nature. So, while classical approaches with static assumptions happen to be ineffective, the DSS concept with its great concern in adaptibility is appropriate (See Section 1.2.2).

(v) If an overall DSS capability is planned to be installed in an organization using a staged development approach, the choice for the initial DSS is very important. It should adress a recognized need with promise of early observable benefits. Thus, the users will be motivated and willing to participate, which means that the implementation will be easier and the risk of obsolesence will be smaller.

The solution to chronical quality problems offer high probability of observable benefits. So, it seems a good place

to start before building a general DSS to support all QC activities.

These are the main characteristics which justify the building of the DSS that will be described in the following sections of this study. The same characteristics and some more which will become apparent later in this chapter, are tried to be built into the DSS when designing it.

2.2. DECISION STEPS

Decision steps in finding remedy to chronic quality problems can be examined using the typical system analysis approach of five phases:

(i) Problem identification: Identification of the chronic problems accounting for the most of the losses related to quality.

(ii) Problem investigation: Closer investigation of important chronic quality problems for their causes.

(iii) Design of alternatives: Suggesting possible remedies for the discovered chronic quality problems.

(iv) Evaluation of alternatives: Estimation of the benefits possible from the suggested alternatives.

(v) Choice: Deciding which suggestion to implement.

Looking at the same decision using Simon's model(10), the first two steps fall into the "intelligence" phase, the third and the fourth steps make up the "design" phase, "choice" phase is the same.

Since chronic problems will require far-reaching investigation for possible causes and courses of action, the second and the third phases can be interdepartmental. Nevertheless, the first attack will come from the QC department, for most of the time.

Below those decision steps are explained in the context of the specific decision.

2.2.1. Problem Identification

The starting point for any quality improvement program is an investigation of the current quality performance, to bring chronic quality problems into daylight. This requires a cost oriented analysis which spots vital few problem areas amongst trivial many, and thus helps identifying opportunities for reducing quality costs. "Failure Analysis" can be regarded as a systematic Pareto analysis serving this purpose.

2.2.2. Problem Investigation

The emergence point of these important chronic quality problems should be found out by investigating whether they are related to machine or operator error or to the technology used, or the management, itself.

2.2.3. Design of Alternatives

According to the cause discovered in the second step, a number of changes in purchasing, maintenance and personnel policies, in machines, technology or production management can be suggested. The inspection plan can be changed in various ways, trying to take the problem in control.

2.2.4. Evaluation of Alternatives

Some of cost and status changes that will be caused by the suggested alternatives can be estimated using available data and the remaining can be estimated subjectively. Thus, the expected quality improvement can be compared with the required additional investment, personnel costs and other draw backs due to the change.

2.2.5. The Choice

Depending on the type of the problem and the precaution, the decision can be made within the Quality Control Department or at higher management levels.

2.3. THE POSITION OF THE SPECIFIC DSS IN THE OVERALL DECISION MECHANISM

The specific DSS developed in this study, which will be called QCDSS from now on, supports the decision discussed above in the Failure Analysis (Section 2.1.1) and in the estimation of possible consequences of suggested alternatives on costs and quality level (Section 2.1.4). Furthermore, it provides the decision-maker with a framework within which he can generate his alterantives easily and quickly, thus it contributes to the design phase, too.

The Failure Analysis and cause investigation following it, can result in the launching of a quality improvement project aiming to get rid of the chronic problem(s) identified. Such a decision is a "pooled interdependent"(14) one, i.e., it will be taken by a group of managers from various departments as a result of some negotiation and interaction. And, it is a management control decision which will result in

a change in one or more of purchasing, maintenance, personnel or production management, in machines or the technology used or in the product, itself.

On the other hand, there may be cases when the discovered problem cannot be solved in this way, or the timing may not be appropriate for such a project to be started, or the cause of the problem may be unknown. In such a case, the inspection plan should be revised in order to get control of the newly discovered critical points or to reduce scrap and rework costs by detecting vital defects as early as possible. This is an "independent" decision which the QC department has to repeat at rather short intervals, and it is on "operational control" level.

Quality Control activities in an industrial organization can be classified in compliance with Gorry and Scott Morton's framework(12) as in Table 2.1. It can be seen on this figure that the components of QCDSS lie in Operational Control and Management Control columns.

Figure 2.1 gives another representation of the position of QCDSS in decision mechanism, this time together with the information network it is embedded in.

2.4. THE POSITION OF THE SPECIFIC DSS IN INFORMATION FLOW

The position of QCDSS in information flow has importance with regard to the ease in implementing it and the cost/benefit analysis.

Nearly all of the data requirements of QCDSS will be satisfied within the QC department. Only in calculating Quality costs there is need for some input data from the

TABLE 2.1- QC activities classified according to types of decisions and degree of decision structure

	OPERATIONAL PERFORMANCE	OPERATIONAL CONTROL	MANAGEMENT CONTROL	STRATEGIC PLANNING
STRUCTURED ↕ UNSTRUCTURED	Conformance and fitness-for-use decisions Process Control Incoming Material Acceptance	Quality Cost Analysis Quality Performance Evaluation (Failure Analysis) Revision of the Inspection Plan	Training Program Decisions Personnel and Equipment Allocation Budget Preparation Quality Improvement and Cost Reduction Projects	Quality Policies: - level of quality - life cycle cost - QC organization
	Decisions that are made in performing the operations	Decisions related to assuring effectiveness in performing operations	Decisions related to assuring effectiveness in acquisition and use of resources	Decision related to setting policies, choosing objectives and selecting resources

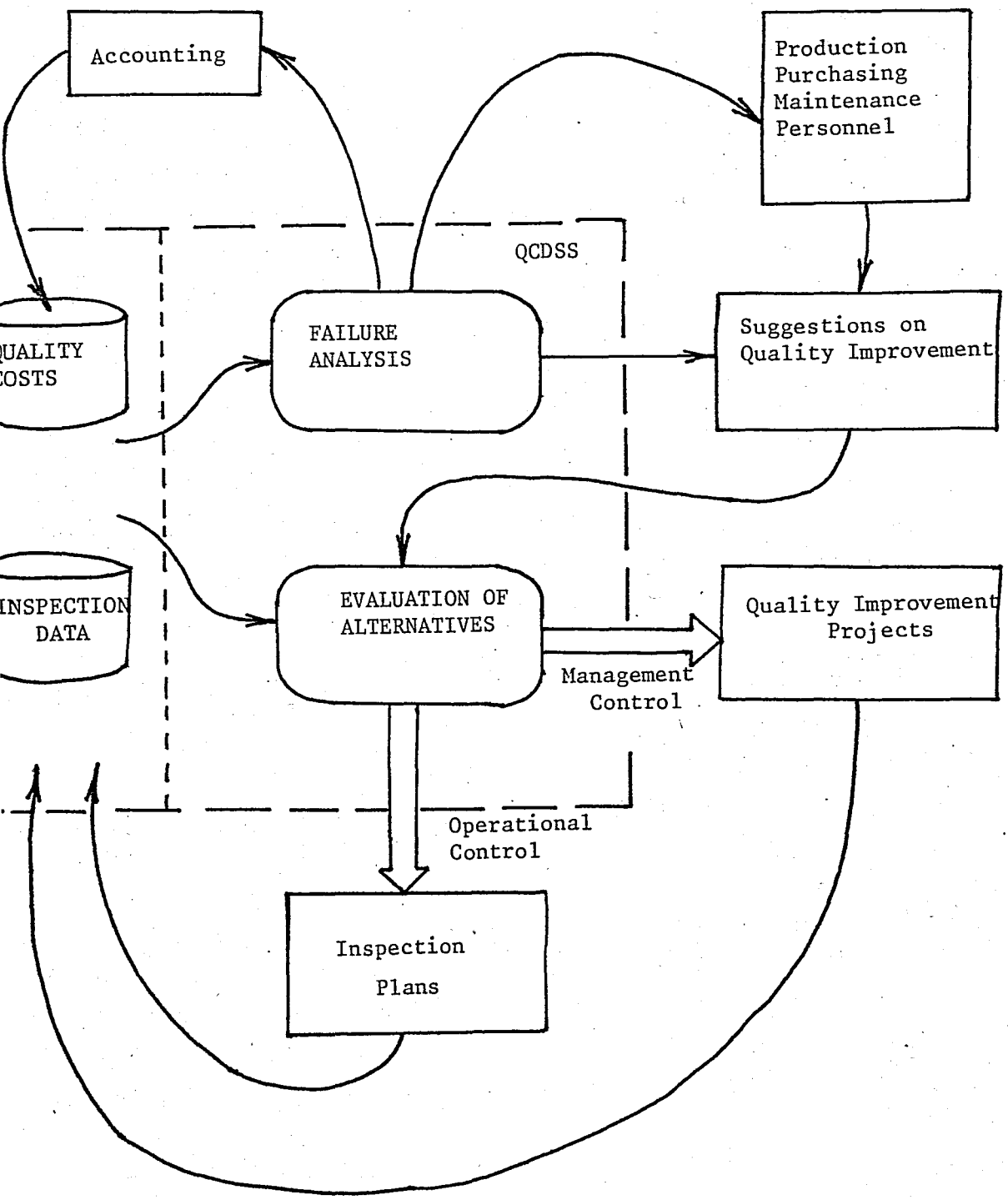

FIGURE 2.1- Position of QCDSS in the Decision Mechanism and in the Information Flow

Accounting department (See Figure 2.1). A description of the current inspection plan, daily inspection and scrap data and data on quality costs should normally be available in a QC department, anyway. Therefore QCDSS does not bring any additional burden in data collection. The data base is designed as easy to use as possible, and moreover, in a way to facilitate adaptation to charges in the quality control system. These issues which will be discussed in detail in Section 3.2.1 are factors that decrease the cost of implementing such a system.

Although information that can be received from production, maintenance, purchasing and personnel departments, i.e., maintenance programs, new purchasing contracts, etc., do not reside in the system, they can be reflected to the decision-making process by the decision-maker through the use of flexible dialog capability of QCDSS.

QCDSS, beyond its main purpose, produces many kinds of information. Most of the reports to be distributed to the Production Department and to upper management by the QC Department can be prepared by using the report generating capability of QCDSS.

Moreover, Failure Analysis can generate some valuable information for production, maintenance, purchasing, and personnel departments. By adding a periodic pre-formatted report generator, the system can release exception reports and historical information for managerial review.

Although beyond the real scope of a DSS, such capabilities are important since they will increase the benefits obtained from the system and thus its cost-effectiveness and value in the eyes of the management.

III. AN APPLICATION IN A LIGHT BULB FACTORY

The Specific QCDSS described in Chapter II is designed for the Quality Control Department of a light bulb manufacturing company. In this chapter, bulb manufacturing and the present QC application in this factory will be described first, and then the interactive computer system developed will be discussed in detail.

3.1. CURRENT QC APPLICATION IN LIGHT BULB MANUFACTURING

The light bulb factory mentioned above, works on three product groups producing a variety of incandescent, fluorescent and mercury vapor lamps.

Flowcharts for manufacturing processes of incandescent, fluorescent and mercury vapor bulbs are given in Figures 3.1, 3.2 and 3.3, respectively.

In the present QC application, the focus is on incandescent production and records are complete only for this product group. Therefore, here, the QC application on incandescent production will be described. For the same reason, incandescent production is a natural starting point for the implementation of QCDSS and although the system is designed in a way that can handle any number of product groups, all

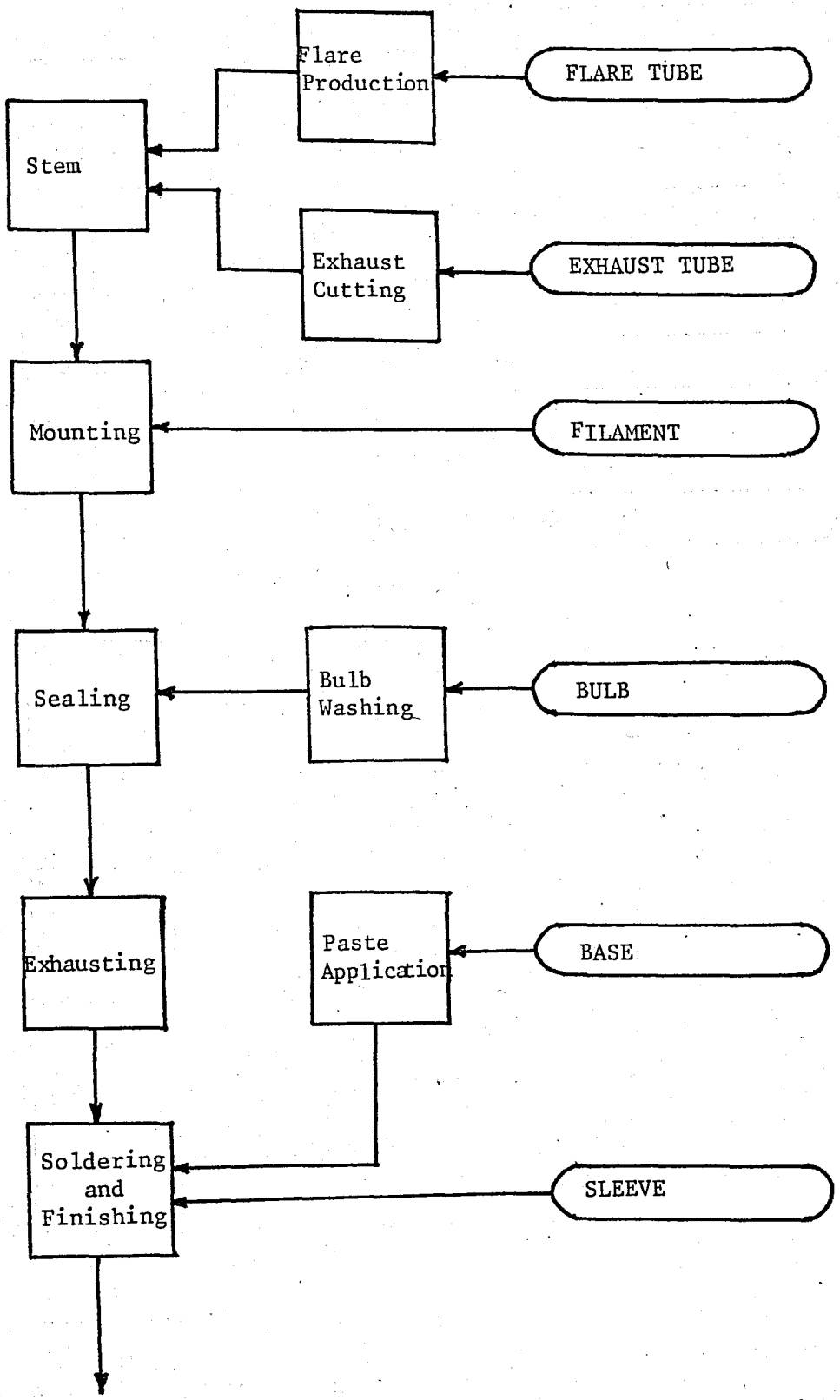

FIGURE 3.1- Incandescent Light-bulb Manufacture

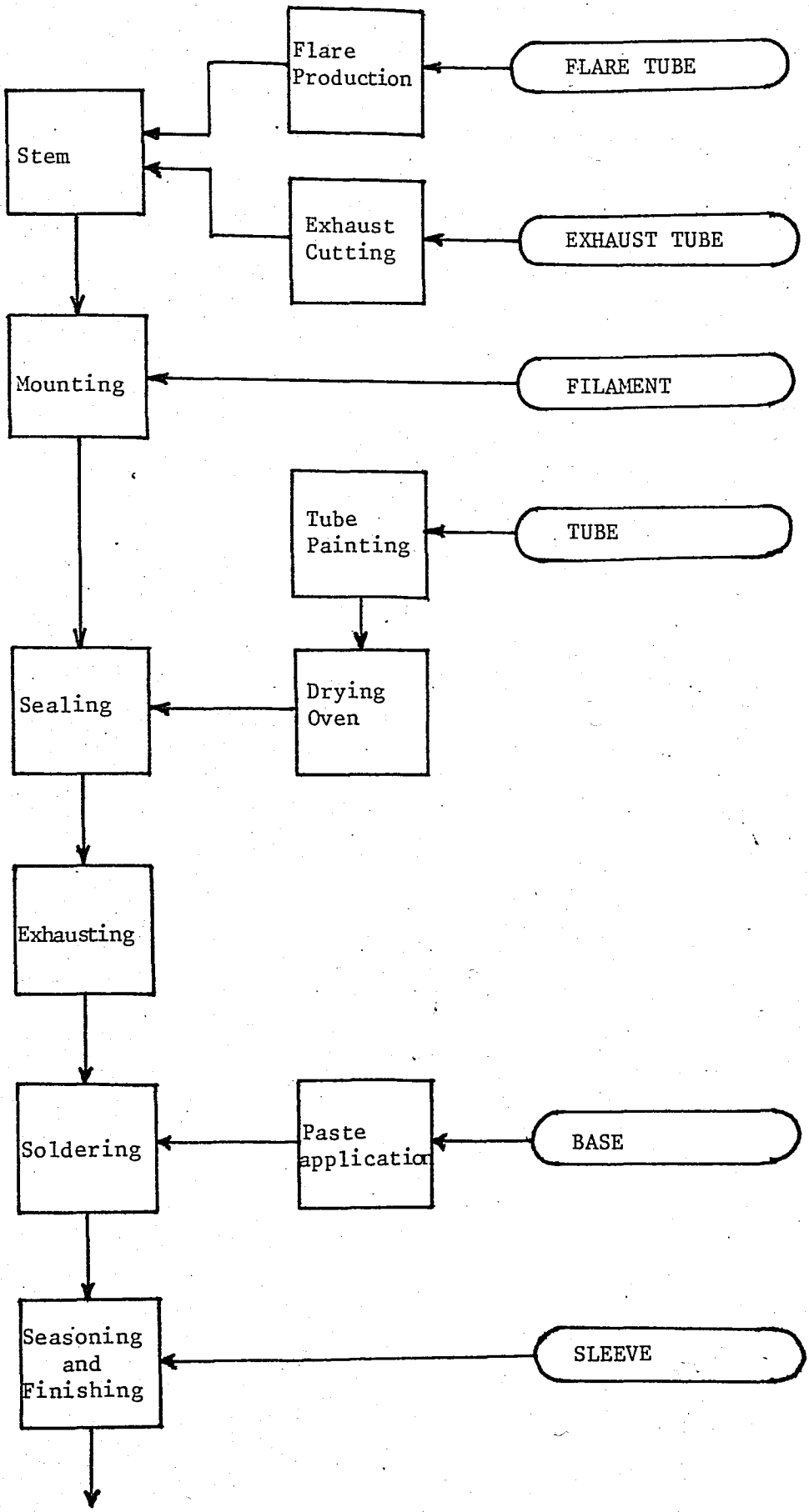

FIGURE 3.2- Fluorescent Lamp Manufacture

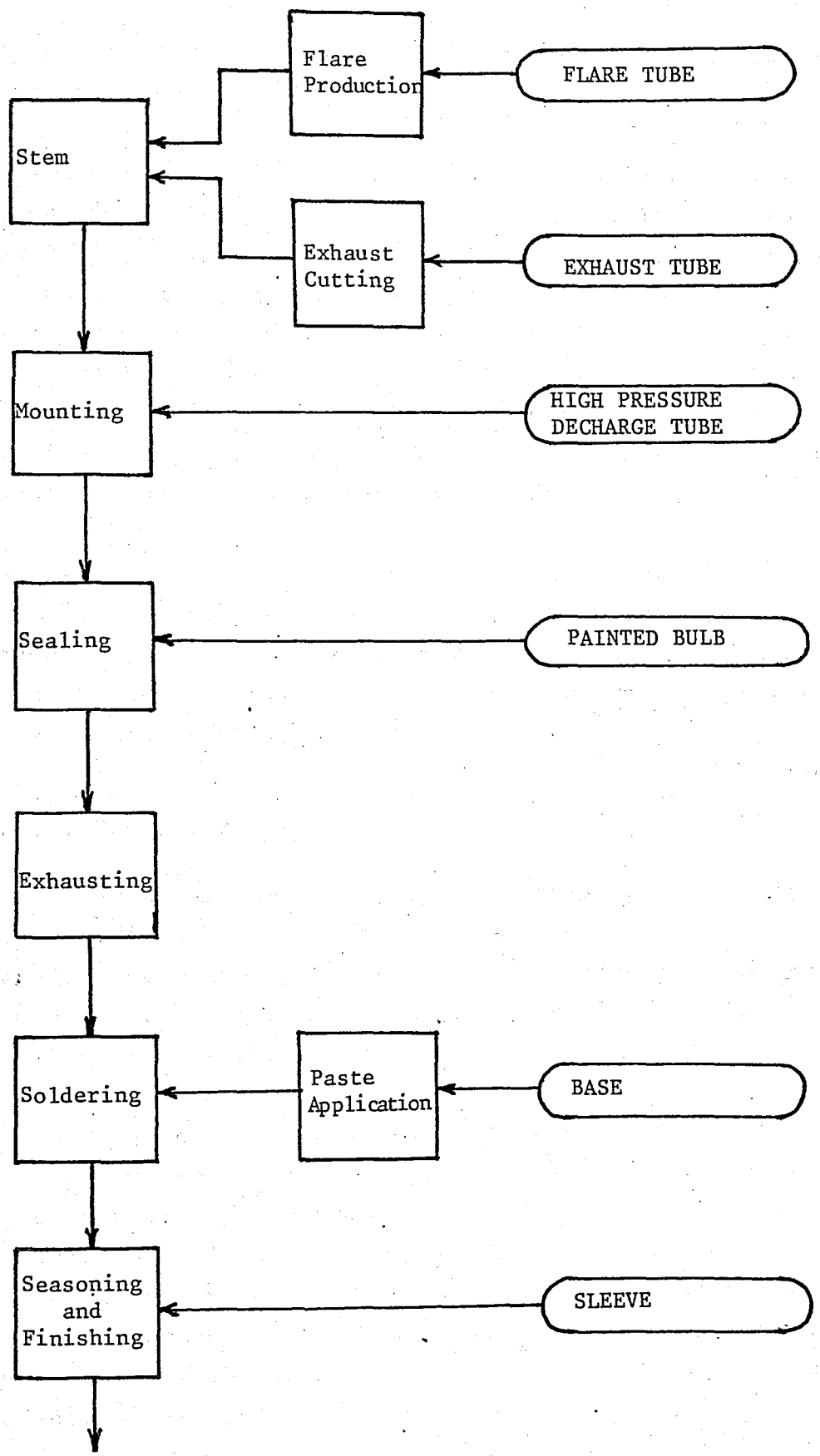

FIGURE 3.3- Mercury Vapor Lamp Manufacture

the examples given further in this study will be on incandescent production.

There are five main operations in incandescent production: Stem production, mounting, sealing, exhausting and finishing. Sealing and exhausting operations are conducted on a composite machine and from now on the term "Sealex" will be used for those operations.

A line consisting of these four machines is called a machine group. For each production type there are a number of machine groups working for two or three shifts.

The main characteristic of bulb production is that it is a continuous production. The number of bulbs produced is dependent on the particular machine group and the shift, but roughly speaking, it is about 10-15 thousand bulbs per shift on a machine group.

3.1.1. In-Process Inspection

During production process, inspection is made on two control stations on each machine group. First control station is after mounting and is called "Stem and Mount Control". Second station is after the last operation and it is called "Sealex and Finishing Control".

All controls made during production are attribute controls where bulbs are inspected visually. Inspection is made by visiting the control stations at certain time intervals and picking defective bulbs until a box of 120 nondefective bulbs is produced. Each time, the defectives caught are recorded by defect type on defective report sheets. By the end of the shift, the numbers are summed to get daily defective numbers.

Figure 3.4 gives main types of defectives that may be produced at each operation. The control stations and main defective types observed at these stations are shown on Figure 3.5. A typical characteristic of bulb production is that, a defective produced at any stage can be caught at any one of the following control stations.

An essential feature of the control procedure is that it is not a rectifying type of procedure, i.e., whenever some sign of low quality production is observed during inspection, the production is not stopped to screen the items produced, but the operator is made aware of the situation to make necessary adjustments, aiming to restore quality of future production.

Thus, although this inspection procedure is not a control chart application, it certainly has certain features of control chart applications.

3.1.2. Finished Product Inspection

After being aged for three days, a sample of 5 % is taken from finished incandescent bulbs. This sample is collected by randomly picking 6 bulbs out of 120 of each box produced, and thus forming a sample box for every 20 production boxes.

"Glow" and "Light" tests are performed on the sample and the defectives caught are recorded. All of the remaining production is taken to glow test, thus 100 % inspection is applied for glow test. However, glow test is not sufficient to screen all defective bulbs. So, light test is carried on for those portions of the production which are represented by the sample boxes rejected in light control. Rejection of a sample box in light control depends on the seriousness of

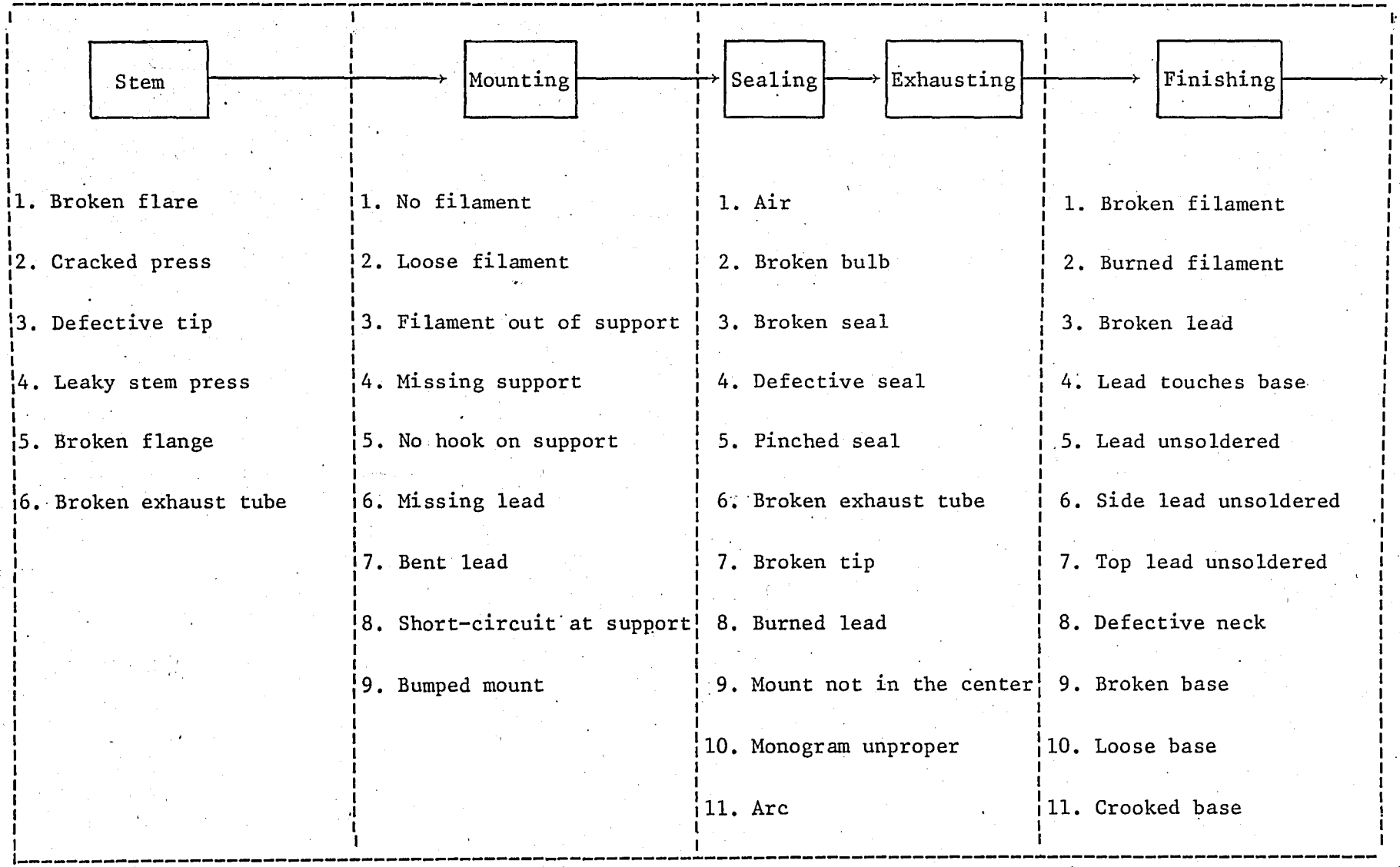

FIGURE 3.4- Main defective types produced at each operation

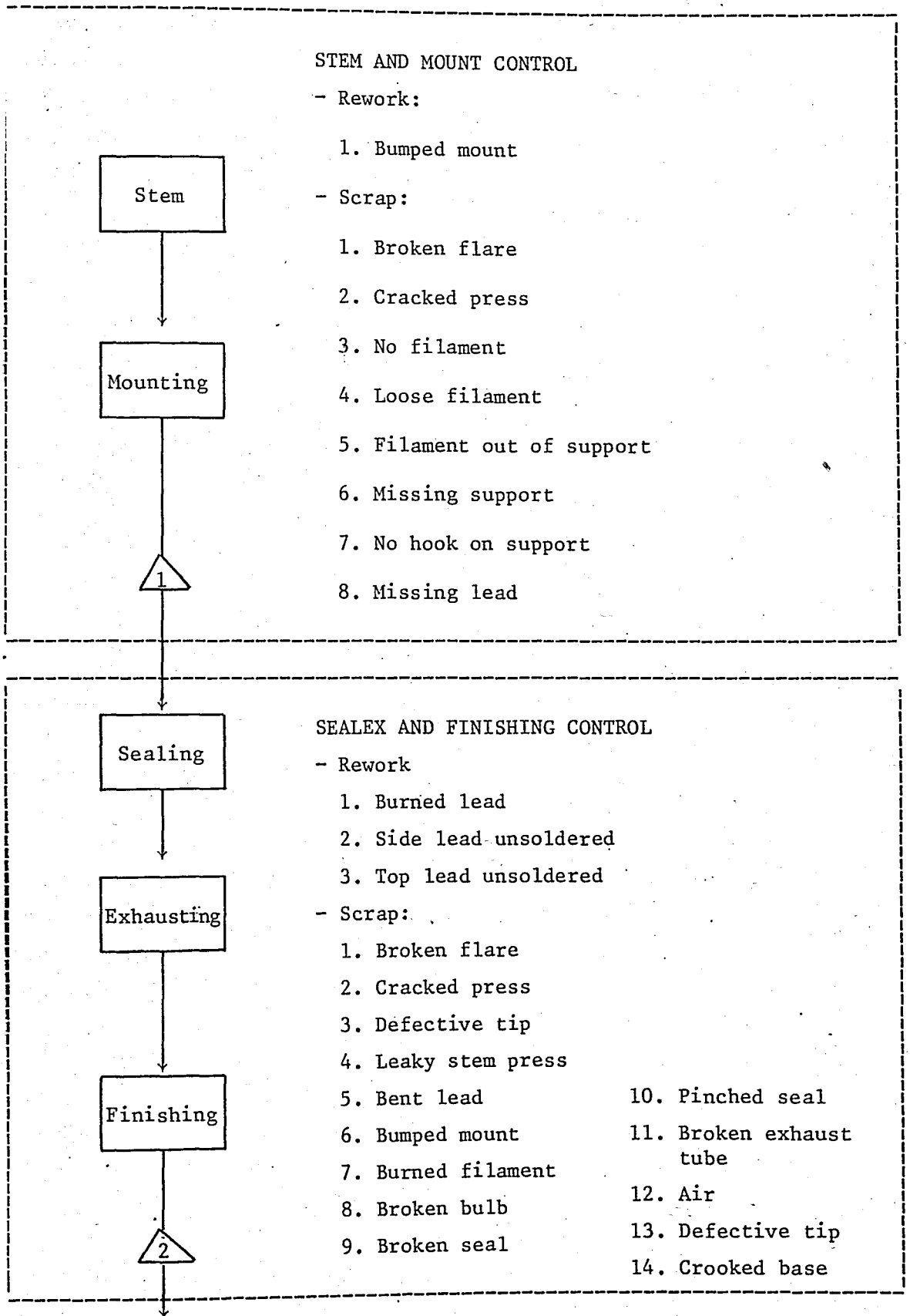

FIGURE 3.5- Control Stations in Incandescent Lamp Production

defect types observed. In the present application, this decision is completely intuitive and does not comply with any preset criteria. However, in the newly developed system, it is proposed to assign certain penalty points to each class of defectives and to reject a sample box whenever the sum of penalty points reaches a specified limit. Table 3.1 shows the seriousness classes and the suggested penalty points.

TABLE 3.1- Table of seriousness classes for defect types

Seriousness Code	Seriousness Definition	Penalty Points
B1	Slightly mars the lamp appearance	2
B2	Materially mars the appearance	5
C1	Slightly effects performance	10
C2	Materially effects performance	25
D	Lamp will not operate	50
E	Lamp may damage surrounding equipment, persons etc.	150

3.1.3. Laboratory Tests

In laboratory a number of photometric tests such as life tests, and measurements of electrical characteristics are carried on samples of finished bulbs. The results of these tests are submitted to upper management as quarterly reports.

Laboratory test are excluded from this study.

3.2. THE PROPOSED SYSTEM: QCDSS

The proposed system has the three major components of a DSS: Data, Models and Dialog (See Figure 3.6).

(1) Data Subsystem

The data subsystem consists of data files and data base management software.

Data files are the inspection data files, quality costs files, defect types file and inspection plans file. These files will be discussed in detail in Section 3.2.1.

Data base management software consists of data input, file generation, update, listing, query and retrieval functions.

(2) Model Subsystem

The first model, which is developed to support problem identification phase is used as a systematic Pareto analysis model to be employed in the investigation of the current quality performance. It is called "Failure Analysis" model and described in Section 3.2.2.

The second model is a Monte-Carlo simulation type of model, to be used in the alternative evaluation phase of the decision, on a what-if basis. It estimates system parameters and calculates expected values for performance measures. This model which is called "Revision of the Inspection Plan" will be described in Section 3.2.3.

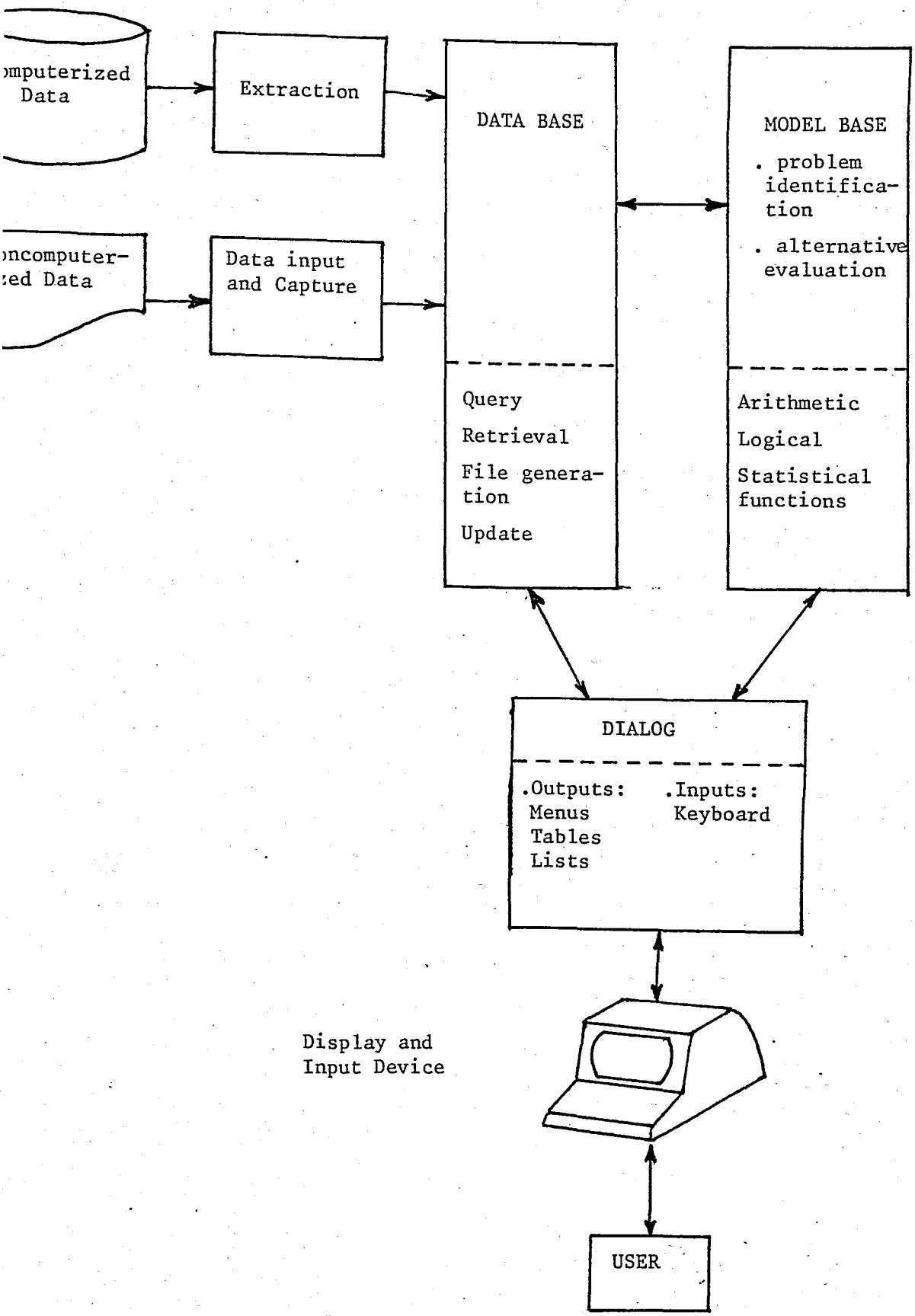

FIGURE 3.6- Components of QCDSS

(3) The Dialog Subsystem

The system is designed on Commodore 8065 microcomputer with full-screen graphics terminal and lineprinter as output media and the keyboard as the input medium.

QCDSS combines menu driven and question/answer dialog styles. The dialog is in Turkish.

The dialog subsystem produces output representations such as tables and reports. It enables the user to invoke and provide parameters for the operations. It supplies memory aids such as "libraries" for preserving intermediate results for later use, "links" for remembering data from libraries for reference while operating, and "profiles" to store default and status data. It provides some control aids such as error messages, warnings and the ability of changing the results of certain operations.

During the design of the dialog subsystem, it was aimed to minimize the number of input errors, to supply a wide variety of alternative choices at each decision point and to develop a system as easy as possible to use.

In the following sections it will become clearer how the dialog subsystem facilitates the mechanics of using QCDSS.

3.2.1. Data Files of QCDSS

Inspection Data files are the source files of QCDSS. Beyond them, there are a number of other files which can be called Support files. These are Quality cost files, Defect Types file and Inspection Plans file.

When designing these files, the main consideration has been that they should be adaptive to any change in the existing system. This is a very important issue, which will avoid the problem of the DSS becoming obselete when a change occurs in the decision environment.

The second consideration taken into account was that these files should be designed in a way to allow utilization for different purposes, instead of being bound to the specific QCDSS.

(1) Inspection Data Files

For each product group, two inspection data files are designed:

(i) In-process inspection data file
(ii) Finished product inspection data file

Both are direct access files.

The raw inspection data, in other words the daily defective reports, will be input to the system everyday. During data input the system operates on this data adding to it some information-i.e. defective costs by type and total daily cost. This is done to reduce number of operations while the system is being used.

To minimize the data input errors and obtain high data reliability, various checks are made during data input. In addition to that, to make data input as easy as possible the design of file records are very similar to defective reports. Since a separate record sheet is used for every machine group/shift/control station combination, the file records are arranged in the same manner (See Figure 3.7).

DATE	LAMP TYPE W/V	BULB DESCR.	COLOR	PRODUCED AMOUNT	INSPECTED AMOUNT	TOTAL DEFECTIVES	REWORK	SCRAP	TOTAL COST	DEFECT	
										CODE	QUANTITY
01/01/84	100/220	Normal	Clear	8500	780	70	2	68	3950	101	1
										102	3
										–	–
										–	–
										⋮	⋮
										–	–
01/01/84	100/220	Normal	Clear	8320	750	---	---	---	---	–	–
										–	–
										–	–
										⋮	⋮
										–	–

*Record for the first control station on the i^{th} machine group/shift.

*Record for the second control station on the i^{th} machine group/shift.

FIGURE 3.7- Contents of a record in In-process Inspection Data File

As a result of these efforts, data input procedure does not require any specially trained personnel.

Inpection data files are read by the help of an auxiliary file called "Description" file. This file describes the way records are arranged. In this way, the data files are independent of number of product groups, machine groups, shifts and control stations and this enables them to be easily adapted to any change in the existing QC system.

(2) Quality Cost Files

QCDSS uses quality cost figures as a measure when identifying problem areas and evaluating alternative precautions, since monetary terms are the most meaningful measure for the managers.

In order to do this, unit cost for every defect type is calculated. Defect cost is considered to have three components:

a) Material Cost: It is the total cost of material that will be wasted on a defective bulb when it is caught. For instance, when a defect of "loose filament" with code 222 is caught at Stem and Mounting Control, 1 exhaust tube, 1 flare, 2 leads, 1 support, and 1 filament are wasted.

b) Labor Cost: When calculating unit labor cost, if total labor cost is divided by total net production amount, then the labor spent for defectives is being distributed on non-defective products. However, when considering quality costs, the aim is to find out the real amount of labor spent on a bulb by the end of production process, so that when a defective bulb is caught, the amount of wasted labor will be known. Because of this, instead of using the method generally used by accountingdepartments,

the labor cost is calculated by using the following method:

Net amount of production	: A	units
Theoretical material cost(*)	: B	TL
Realized material cost(*)	: C	TL
Total shrinkage	: D=C-B	TL
Theoretical unit material cost	: E=B/A	TL/unit
Equivalent units to shrinkage	: F=D/E	units
Gross amount of production	: G=A+F	units
Total labor cost	: H	TL
Net unit cost of labor	: I=H/G	TL/units

(*) Unit material costs should be the same

However, since labor utilization at different machine groups are different, this net unit cost of labor is not sufficient. The unit cost of labor should be calculated separately for each machine group.

Total net labor cost	: J=AxI	TL
Net production for machine i	: a_i where $\sum_j a_j = A$	units
Planned production rate for machine i	: k_i	units/hour
Labor utilization index	: $\ell_i = a_i/k_i$	hours
Net labor cost assigned to machine i	: $m_i = J x \ell_i / \sum_j \ell_j$	TL
Net unit labor cost for machine i	: $n_i = m_i/a_i$	TL/unit

Now, it should be found out how much of this net unit labor cost is added to the cost of a bulb at each production stage. In this way, labor cost of defective bulb will be assigned according to the stage it is caught.

For this distribution to be made, operation time and difficulty, number of workers and worker qualification at

each stage of production should be considered. It is observed that, on a machine group production stages do not differ significantly from these respects, therefore the unit labor cost can be distributed equally.

c) Indirect Production Costs: The indirect production cost to be assigned to a defective item is calculated by using a specified ratio (r) of the sum of material and labor costs of that defective item. This ratio is obtained by dividing total indirect production costs to the sum of total material and labor costs of the previous period.

The cost of a defective light bulb calculated in this way is dependent on the defect type and the stage the defective is caught. Therefore these cost figures by defect type are stored at four different files for four candidate control stations. In this way adaptation to any change in the locations of control stations will not be a problem.

These cost figures should be updated whenever necessary by using estimates of production amount, material cost, labor cost, and indirect production costs for that period.

(3) Defect Types File

The necessary information for all defect types observed in light bulb manufacturing is stored in a direct-access file. The contents of a record are shown on Figure 3.8. The key field is the defect code. The "related operation" is the production operation during which that particular defect is produced. "Seriousness class" indicates the class of the defect.(See Table 3.1).

Defect Code	Defect Description	Related Operation	Seriousness Class
101	Arc	Sealex	B1
103	...	...	..

FIGURE 3.8- Contents of a record in Defect Types File

Operations	Previous Plan			Date of change	Current Plan		
	Code	Parameters			Code	Parameters	
1	-	-	-	-	4	-	-
2	1	780	-	01/03/84	3	0.05	120
3	4	-	-	01/03/84	1	780	-
4	2	-	-	01/03/84	4	-	-

FIGURE 3.9- Contents of a record in Inspection Plans File

(4) Inspection Plans File

This is a direct-access file where the current and the previous inspection plans are stored (See Figure 3.9). For each machine group/shift/operation combination there is a record. The inspection plan on that combination is indicated by a code, including a "no inspection" option.

3.2.2. Failure Analysis Module

Failure Analysis Module is developed to support the problem identification phase of the decision (Section 2.1.1).

It provides the decision maker with a variety of processed views of the data base aggregated from different angles.

This is done in an interactive mode. The user chooses the views -or, tables- he wants to see, one after the other in a way that leads him to a decision. How this is done is represented on Figure 3.10 and is explained below.

The program starts with an "Analysis Level Menu". As seen on Figure 3.11, analysis can be made on six levels. When designing these six levels, all views a decision maker may need during the analysis and the structure of production in the factory are taken into consideration.

In the "General" level the user can compare the performance on three product groups.

In the "Product Group" level he can examine a specific product group by its lamp types.

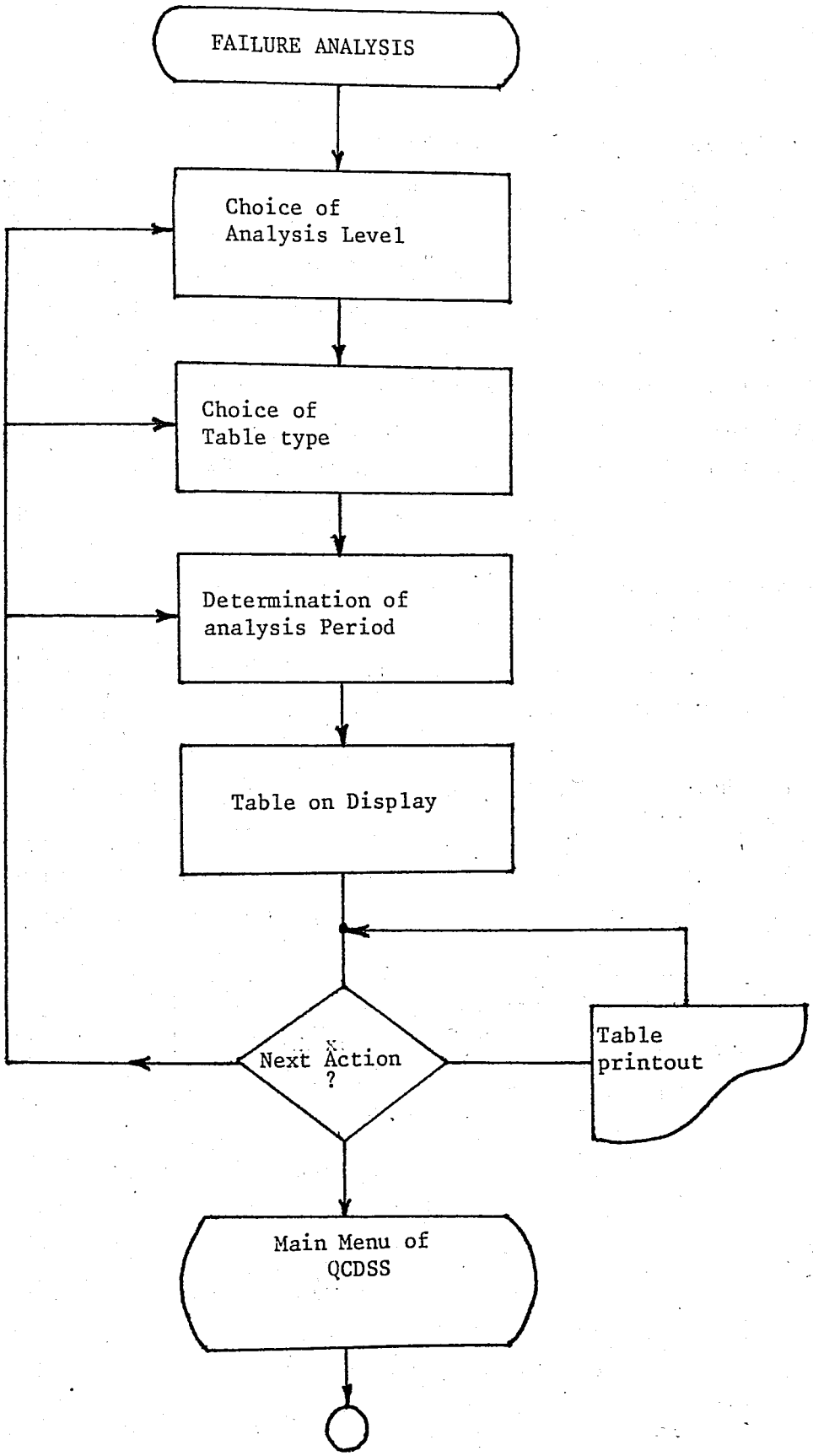

FIGURE 3.10- Failure Analysis Module as the User sees it

In the third level which is "Lamp type" both the product group and the lamp type are specified and the user can compare the performance in the control stations belonging to that combination. The term "lamp type" applies to the wattage of the light bulb.

The next level is the "Control Station". Here, the user can investigate the performance by machine group or by lamp type for a specific control station of a specific product group.

In the last two levels - "Control Station/Machine Group" and "Control Station/Lamp type" - everything being specified the window gets smaller and the user can observe the performance at a particular point in the production.

In this manner, as one comes down the menu, the scope of the analysis gets narrower. This enables the decision maker to start the analysis anywhere and then gradually focus on the problem he discovers.

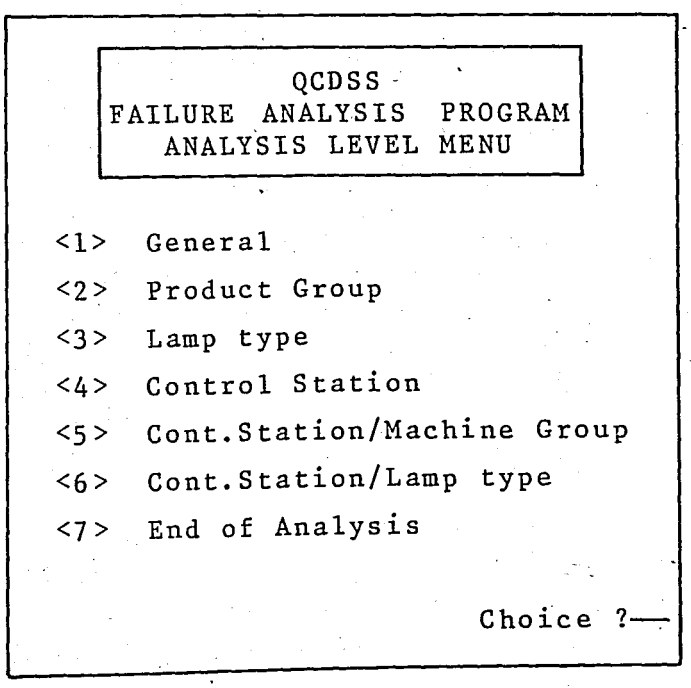

FIGURE 3.11- Analysis Level Menu

After the analysis level is specified, it comes to the choice of the particular table. For this purpose, a separate "Table menu" is prepared for each analysis level and the alternatives provided to the user are listed.

On these "Table Menu"s three main types of tables are present:

(i) For the Overall Period: It is the aggregation of Information for the overall of a period specified by the decision maker.

(ii) Time-series: The analysis period is divided into time intervals of length specified by the decision maker. In this way, the quality performance changes during a particular period can be observed.

(iii) For the First Five Defect Types: On this type of table, detailed information on the five defect types observed in a specified period are given. These five defect types are the ones whose cost weight during the period are the highest. This table type can give important clues for cause investigation.

Second type of tables require additional parameters to get constructed.

First one is the type of information to be tabled. There are two alternatives:

(i) defective percentage
(ii) cost weight in percentage

Secondly the length of the time interval needs to be specified. There are three alternatives:

(i) week
(ii) month
(iii) quarter

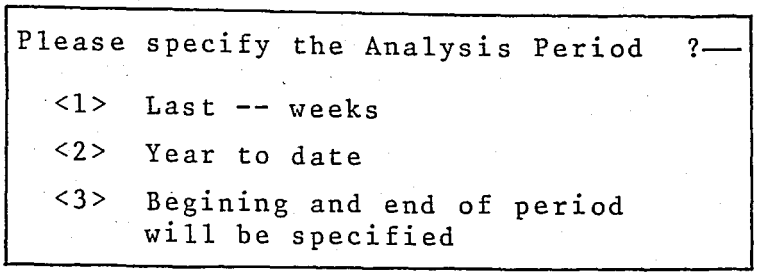

FIGURE 3.12- Determination of the Analysis Period

After choosing the table type, the decision maker specifies the analysis period. There are three alternative ways to do this and they can be seen on Figure 3.12.

Everything thus being specified the table is displayed to be examined by the decision-maker. He can also take a print-out if he wishes to.

As the next step, the decision maker may wish to see a new table at the same or a different level. This operation is repeated as many times as the decision maker wishes.

By the end of the analysis, the decision maker is expected to gain a clear notion of the current quality performance, spot the main problem areas and get some clues about the causes of problems.

Available table types for all six analysis levels are explained in Appendix A. It is aimed to give the decision maker as many alternatives as possible, but of course, a decision maker will use the ones that are most meaningful to him. This set of tables can be different from user to user.

In fact, after the system is implemented it will become apparent which tables are used most and whether the contents of the tables are sufficient. This experience may lead to the adaptation of the system to the decision maker's needs and cognitive style.

3.2.3. Revision of The Inspection Plan Module

In the fourth phase of the decision process which is the alternative evaluation phase (Section 2.1.4), the decision maker needs a tool that helps in estimating the consequences of any change in the existing system.

This module has been developed for this purpose. It gives the decision maker a measure for comparing various alternatives on a what-if basis, without any effort for an optimization. In fact, an optimization approach would hinder the integration of the experience and the judgements of the decision-maker, which can be very important for this case. Furthermore, such a technique would not permit user participation in alternative creation, making the system a black-box.

This module, however, allows the decision maker to apply his job specific experience and his own heuristics in creating and comparing alternatives. In this way, the decision-maker will gain a thorough understanding of the system behavior and will have the opportunity of experimenting with the system. Furthermore, the number of alternatives to be tried is not too many in real-life problems.

The module is designed to estimate the parameters of the current quality system in practice, get the decision variables from the user through alternative generation and calculate the expected values for performance measures using

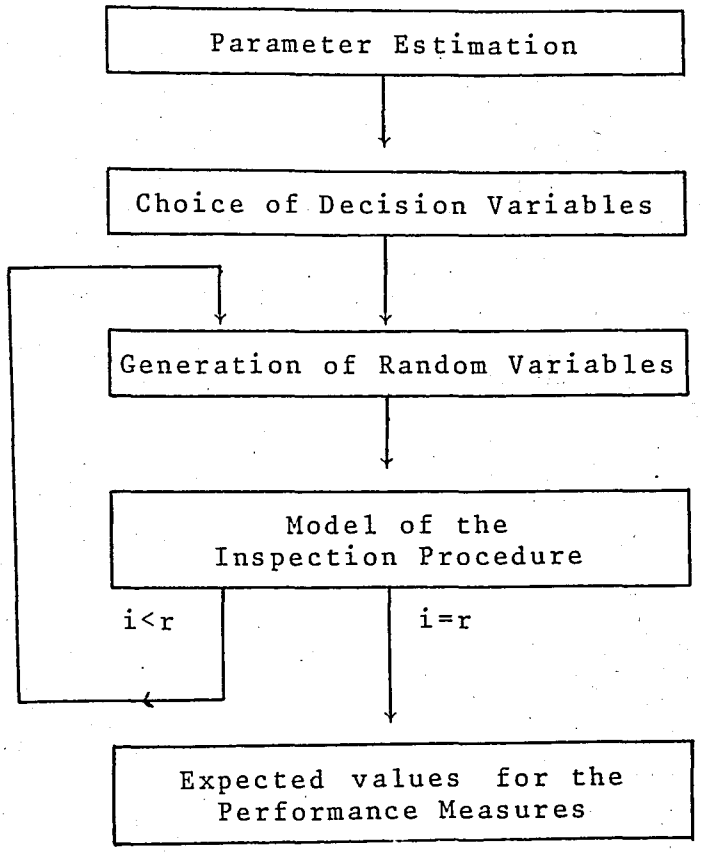

FIGURE 3.13- Monte-Carlo simulation model used in evaluating the alternatives

a Monte-Carlo simulation approach (See Figure 3.13). This cycle is repeated, each time preserving the results for future reference until the decision maker comes to a decision. Thus the model integrates and supports design and choice activities of the particular decision problem.

The mechanics of the model, as the user sees it, is represented in Figure 3.14.

The inspection procedure is modelled as in Figure 3.15. The model represents the existing inspection procedure as well as the alternative procedures that will be created by the user by changing the decision variables.

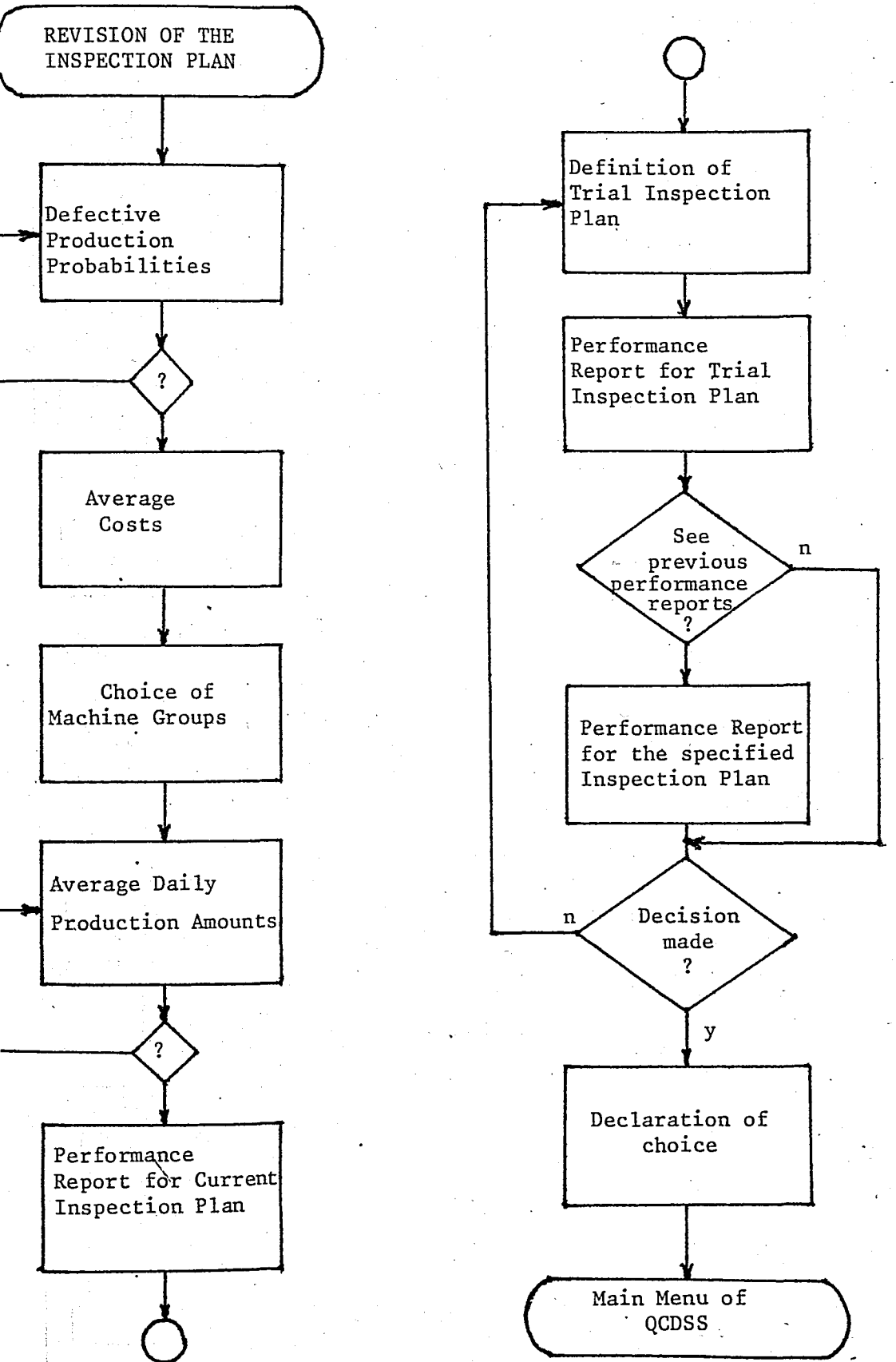

FIGURE 3.14- The Revision of the Inspection Plan Module as the user sees it.

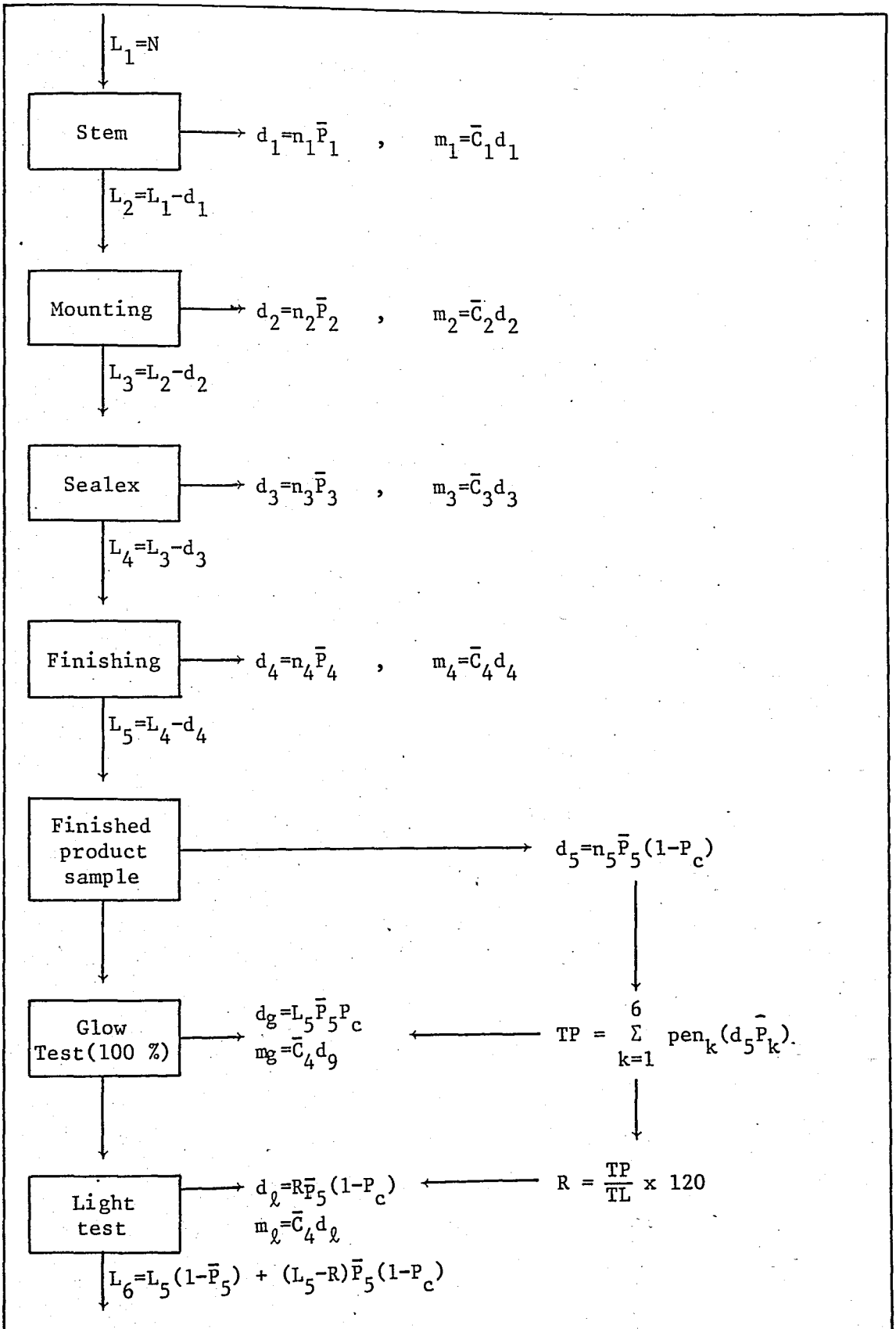

FIGURE 3.15- The Model of the Inspection Procedure

The variables on Figure 3-14 are defined below (for a particular machine group):

N : initial lot size

L_i : the lot size at the beginning of each production phase, where $L_1 = N$ and L_6 is the final amount of finished product going to stock.

d_i : number of defectives caught in sample taken in i^{th} production phase.

d_g : number of defectives caught at 100 % glow test.

d_ℓ : number of defectives caught at light test

n_i : sample size at i^{th} production phase

$\bar{P}_i$: probability that a bulb that has passed i^{th} production phase is defective, with

$$\bar{P}_1 = P_1$$

$$\bar{P}_i = ((L_{i-1} - n_{i-1})(1-\bar{P}_{i-1})P_i + (L_{i-1}-n_{i-1})\bar{P}_i)/L_i$$

for i=2,3,4

$$\bar{P}_5 = (L_4-n_4)\bar{P}_4/L_5 \quad \text{(for finished product)}$$

where, P_i is the probability of a bulb becoming defective during operation i.

P_c : probability of catching the defective on glow control given that the item is defective.

$\bar{P}_k$: probability that a defect caught in sample light control belongs to seriousness class k.

pen_k : penalty points assigned to a defect of seriousness class k.

TP : total penalty points of the defects observed in sample light control.

PL : penalty limit for rejecting sample boxes during light control.

R : number of items to take light control, decided as a result of rejections in sample light control.

$\bar{C}_i$: average cost of a defective bulb caught at i^{th} production phase. Average cost of a defective finished bulb equals to C_4.

m_i : total cost of defectives at i^{th} production phase.

The initial lot size (N) is taken as a random variable distributed uniformly between upper and lower limits for daily production which are set by the decision-maker. So, the limits of the uniform distribution are decision variables.

Other than that, the process average of i^{th} operation, (P_i), is regarded as a normally distributed random variable with mean P_i' and standard deviation, σ_i'. The Central Limit Theorem is used in making this assumption.

The mean, P_i', and the standard deviation σ_i' are parameters to be estimated by the system. The other parameters are the probability of catching a defective in glow control (P_c), the probability that a defect in light control is from seriousness class k ($\bar{P}_k$), and the average cost of a defective at each stage of production ($\bar{C}_i$). All these parameters are estimated using the sample statistics of a sample consisting of the inspection data of last 20 work days.

The decision variables are related to sampling plans and procedures. Each n_i is a decision variable. There are four alternatives in determining the sampling plan at a particular production phase:

1) The Constant Sample Size Plan: A constant number of items are inspected at certain time intervals. This is the current sampling plan used. The constant daily sample size is the decision variable.

2) 100 % Inspection Plan: This is the extreme case of the previous plan where the sample size equals the lot size.

3) CSP-1: A special set of inspection plans, known as Continous Sampling Plans (CSP), has been introduced for use in continuous production inspection. The earliest CSP, introduced by Dodge in 1943, is referred to as CSP-1. In CSP-1 there are two levels of inspection. 100 % inspection and inspection at a rate of 1/n and there is a simple rule to determine when to change between these levels. A producer operating a continous sampling plan such as CSP-1 may have any or all of three different aims in view(35):

(i) Product screening: The product is to be sorted usually into two grades, an acceptable grade and one which needs to be rejected or rectified.

(ii) Process trouble shooting: The aim is tracing and eliminating the "assignable causes of variation" in product quality.

(iii) Adaptive control: Here the inspection results are to be used to indicate any adjustments needed to the process in order to keep quality up to standard.

The procedure used in CSP-1 sampling plan can be stated as follows:

Inspect every item until i successive items are found free of defects, and then inspect only a fraction f of the units, selecting individual sample units one at a time from

the flow of product, in a manner to assure an unbiased sample. When a defective item is found, revert to 100 % inspection, and continue until i successive items are found free of defects.

The decision variables are, therefore, f and i. Curves giving necessary information for the selection of such a plan for any desired AOQL are given in stratistical Quality Control books(36,37).

The average number of items inspected in a run of 100 % inspection is

$$u = (1-q^i)/pq^i \qquad (3.1)$$

where q=(1-p) and p is the fraction defective.

The average number of items passed under the sampling procedure before a defect is found equals

$$v = 1/fq \qquad (3.2)$$

The average fraction of total produced units inspected in the long run equals

$$AFI = (u+fv)/(u+v)$$

or,

$$AFI = f/(f+q^i(1-f)) \qquad (3.3)$$

The derivation can be found in(35).

In the model, (3.3) is used to determine the average daily sample size when the chosen sampling plan is CSP-1.

4) No Inspection: The last alternative when determining the sampling plan at a certain location in production is making no inspection there. In this case, the particular sample size is simply taken to be zero.

Coming to the finished product inspection, the decision variables are the sample size expressed as a fraction of the lot size (L_5) and penalty points limit (PL) to be used in decisions of rejecting a sample box in sample light test, to determine the number of units to be taken into light test (R) (See Section 3.1.2).

In addition to these, the decision maker is allowed to treat the mean for the process average (P_i') as a decision variable, although it was previously defined as a parameter estimated by the model. He can do this by editing the results of the parameter estimation phase. This is a quite important feature of the model, giving it the ability of experimenting with technological aspects of the system. Thus, a new class of decisions that the system can deal with is introduced, i.e., using this feature, the decision maker can evaluate the consequences of an engineering project aimed at reducing the process average by some amount.

The performance measures made available to the decision maker in evaluating alternatives are:

(i) The cost of defectives at each stage (m_i)

(ii) The total cost of the alternative, defined as

$$M = \Sigma m_i \qquad (3.4)$$

(iii) The cost weight of each stage in the inspection procedure, defined as

$$w_i = m_i/M \qquad (3.5)$$

(iv) The percent defective at each stage of production, $\bar{P}_i$

(v) The average outgoing quality, defined as

$$AOQ = (L_6-R)\bar{P}_5(1-P_c)/L_6 \qquad (3.6)$$

(vi) The material efficiency, defined as

$$E=L_6/L_1 \qquad (3.7)$$

Performance reports for Inspection Plans display all these measures defined above, next to the particular trial inspection plan as defined by the decision-maker.

3.3. USER'S VIEW OF QCDSS THROUGH A SCENARIO

In this section, QCDSS will be demonstrated through a short scenario to make it clear the way it will be used to discover a problem. The figures given on tables are realistic but hypothetical.

By the end of the first month, the Quality Control Manager decides to make an analysis of the quality performance.

He enters the Failure Analysis Module in the Main Menu of QCDSS. He decides to start the Failure Analysis at the Control Station level which is the fourth alternative on the Analysis Level Menu. He specifies the control station as Mount Control which is the first control station in the current inspection plan.

From the Table Menu for Control Station Level (See Appendix A) he initially chooses the first table type, that is Machine Groups compared for the Overall Period. He determines the analysis period as 02/01/1984-27/01/1984

which correspond to the first 20 workdays of the year.

The table appears on screen and he begins to examine it (See Table 3.2). On this table, results for 2 shifts of Machine A and 2 shifts of machine B can be compared. It is seen that second shift of machine A(A/2) displays poor performance, with a considerably higher defective percentage and cost weight when compared to the others.

After making this observation, the user wishes to see the same table, this time for the second control station, on the Finishing Control (See Table 3.3).

Here again A/2 is the worst and the cost figure is even larger for this control station.

The QC Manager wants to get further information about this problem and he decides to examine the situation on time axis. So, he resorts to the third table type on the same analysis level, that is Time-Series Comparison of Machine Groups. First, he demands to see the weekly defective percentages (See Table 3.4).

He makes an important observation on this table. While the defective percentages are about 11 % and seems to be relatively stable for the last 3 weeks for the first shift of machine A (A/1), the defective percentages for the second shift (A/2) are considerably greater (about 15 % on the average) and they tend to increase. When the manager changes the contents of the table for the cost weights, he observes that the cost weight for A/2 is the largest for all weeks (See Table 3.5).

The QC manager begins to theorize on the cause of this problem. Since the machines are the same, this difference on

URUN GRUBU : enkandesant KONTROL NOKTASI : Mont Kontrolu

DONEM : 02/01/84-27/01/84

makina grubu	uretim miktari	kontrol edilen	hatali sayisi	iskarta	tamir	maliyet	hatali yuzdesi	parasal agirlik
A/1	60423	6313	726	724	2	21399	11.50	20.48
A/2	83054	6318	954	950	4	40086	15.10	38.36
B/1	97442	5989	496	496	0	23039	8.28	22.05
B/2	144919	6188	543	540	3	19982	8.78	19.12
Toplam	385838	24808	2719	2710	9	104506	-	100.00

TABLE 3.2. Table for the Overall Period with respect to Machine groups for Mounting Control

URUN GRUBU : enkandesant KONTROL NOKTASI : Ikmal Kontrolu

DONEM : 02/01/84-27/01/84

makina grubu	uretim miktari	kontrol edilen	hatali sayisi	iskarta	tamir	maliyet	hatali yuzdesi	parasal agirlik
A/1	53947	5318	608	256	352	22967	11.43	19.68
A/2	68905	6428	955	485	470	44950	14.86	38.52
B/1	101820	6237	587	184	403	18718	9.41	16.04
B/2	163557	6388	778	335	443	30070	12.18	25.77
Toplam	388229	24371	2928	1260	1668	116705	-	100.00

TABLE 3.3. Table for the Overall Period with respect to Machine Groups for Finishing Control

URUN GRUBU : enkandesant KONTROL NOKTASI : Ikmal Kontrolu

DONEM : 02/01/84-27/01/84
DEVRELER : hafta
[illegible] yuzdesi [illegible] tablosu

makina grubu	1. hafta	2. hafta	3. hafta	4. hafta	ort.
A/1	13.48	10.45	10.90	10.62	11.36
A/2	12.93	14.84	16.21	15.38	14.84
B/1	11.88	7.99	8.57	9.32	9.44
B/2	9.03	13.10	13.18	13.04	12.09

TABLE 3.4. Time-series table with respect to Machine Groups for weekly defective percentages in Finishing Control

URUN GRUBU : enkandesant KONTROL NOKTASI : Ikmal Kontrolu

DONEM : 02/01/84-27/01/84
DEVRELER : hafta
[illegible] tablosu

makina grubu	1. hafta	2. hafta	3. hafta	4. hafta	ort.
A/1	21.72	9.62	26.41	16.87	18.66
A/2	41.18	43.23	33.20	40.32	39.48
B/1	22.00	17.06	17.97	10.09	16.78
B/2	15.11	30.09	22.42	32.72	25.09

TABLE 3.5. Time-series table with respect to Machine Groups for weekly cost weights in Finishing Control

the two shifts can result from either the material or operator error. The use of different material seems to be a far possibility, but the manager decides to learn about that.

Before setting out for action, the manager searches for some further clues. He changes the analysis level to (control station/machine group), the sixth choice on the menu, and thus concentrates on A/2.

On this level he examines the table for the First Five Defects (See Table 3.6). The five defective types listed on this table, account for about 62 % of the total quality cost on Finishing Control of machine A/2, and their cost weights are not too much different from each other. In other words, the defects seem to be equally distributed. This observation strengthens the managers hypothesis that the operator is responsible for the situation. Furthermore, observing that the majority of defects are produced in sealex operation, the QC manager now knows where to look at first when judging the operators.

Thus, developing a hypothesis for the cause of the high defective percentage on the second shift of A/2, which is the most important problem for the time being, the QC manager goes to production to find out whether he is right in his hypothesis.

Let's say that, as he has expected, the material used on the two shifts were the same and that the operator on sealex machine was found responsible of the situation. Assume that some corrective action was taken and after two weeks the QC manager once again applies to QCDSS to evaluate the results.

He examines the Time-Series Table for Machine Groups for the last 6 weeks (See Table 3.7). He observes that the precaution has been effective-the defective percentage falling from 15.38 % to 12.92 % on the 5^{th} week and to

URUN GRUBU : enkandesant

KONTROL NOKTASI : Ikmal Kontrolu
MAKINA GRUBU : A/2

DONEM : 02/01/84-27/01/84
URETIM : 68905 KONTROL EDILEN : 6428

Hata Kodu	Hata tanimi	Ilgili Islem	Miktar	Maliyet	Hatali Yuzdesi	Parasal Yuzde	Biriken Yuzde
610	uc bozuk	stem	89	6980	1.38	18.73	18.73
503	kaynak yeri catlak	sealex	74	5831	1.15	15.65	34.38
500	kavanoz kirik	sealex	66	4079	1.03	10.95	45.33
526	kistirilmis kaynak yeri	sealex	62	4043	.96	10.85	56.18
612	ekzost tupu kirik	sealex	35	2265	.54	6.08	62.26

TABLE 3.6. Table for the First Five Defects for Finishing Control

URUN GRUBU : enkandesant KONTROL NOKTASI : Ikmal Kontrolu

DONEM : 02/01/84-09/02/84
DEVRELER : hafta
Hatali yuzdesi tablosu

makina grubu	1. hafta	2. hafta	3. hafta	4. hafta	5. hafta	6. hafta	ort.
A/1	13.48	10.45	10.90	10.62	11.07	11.00	11.25
A/2	12.93	14.84	16.21	15.38	12.92	9.86	13.69
B/1	11.88	7.99	8.57	9.32	10.94	9.26	9.66
B/2	9.03	13.10	13.18	13.04	11.33	13.02	12.12

TABLE 3.7. Time-series Table for defective percentages for the last six weeks

URUN GRUBU : enkandesant KONTROL NOKTASI : Ikmal Kontrolu

DONEM : 02/01/84-09/02/84
DEVRELER : hafta
Parasal agirlik tablosu

makina grubu	1. hafta	2. hafta	3. hafta	4. hafta	5. hafta	6. hafta	ort.
A/1	21.72	9.62	26.41	16.87	26.40	18.61	19.94
A/2	41.18	43.23	33.20	40.32	28.16	14.99	33.51
B/1	22.00	17.06	17.97	10.09	17.03	9.50	15.61
B/2	15.11	30.09	22.42	32.72	28.41	56.90	30.94

TABLE 3.8. Time-series Table for cost weights for the last six weeks

9.86 % on the 6th week. While this occured, the other machines performed relatively stable, except that on B/2 there was a sudden and short-living recovery on the 5th week, parallel to the event of A/2. This seems an interesting point to investigate.

Actually, when looking at the Time-Series Table for the Cost Weights it comes up that now B/2 has gained importance (See Table 3.8).

This simple scenario will be ended here with the conclusion that while deciding where to attack and evaluating results through the use of Failure Analysis module of QCDSS, the decision maker learns much about the behavior of the QC system.

IV. CONCLUSIONS AND EXTENSIONS

In this chapter, the important characteristics of QCDSS will be summarized and some brief remarks on its evaluation will be made. Later on, some possible extensions to the system will be mentioned.

4.1. IMPORTANT CHARACTERISTICS OF QCDSS

The main features inherent in QCDSS can be summarized in a way parallel to the set of capabilities expected from a DSS (See Section 1.2.3):

(i) It supports decisions which are not so well-defined or clear in the decision-maker's mind. Each chronic problem may require a different solution procedure, i.e. different subsets of data to be searched, different people concerned, different type of suggestions to be made, different judgemental criteria to be considered, etc. Therefore, the decision-makers will have difficulty in defining the solution procedure at the very start, but will find their way out through the use of the QCDSS which will lead them to scientific management approach.

(ii) The two types of decisions that QCDSS support - changing the inspection plan and launching a quality improvement

project - are at operational and managerial control levels, respectively. Thus, QCDSS helps integration of these two levels. This means that, QCDSS can act as a communication medium between levels of management and diffuses knowledge.

(iii) While changing the inspection plan is an independent decision that the QC manager is responsible of, the launching of a quality improvement project is a pooled interdependent decision resulting from the interaction among several departments. Here again, QCDSS facilitates communication and thus increases the chance of successful implementation.

(iv) QCDSS offers some support for all phases of the decision-making process.

Intelligence phase is supported by the Failure Analysis Model for the identification of the problem. This model also provides some clues for the causes of these problems, but statistical techniques to test the significance of each possible cause is not offered by the available system in this initial version.

The design and choice phases are supported by the "Revision of the Inspection Plan" where a large variety of alternatives can be generated, evaluated and compared.

(v) The menu driven, flexible structure of QCDSS makes it process-independent, allowing the user apply its capabilities in a sequence and form that fits his own cognitive style.

(vi) The ease of use has been one of the main concerns in designing the QCDSS. It does not require the user to have any knowledge on computers.

(vii) The modular approach used in designing the QCDSS makes it highly adaptible to changes, i.e., additions or deletions of submodels are easy and changes in the system can be easily accomodated into the QCDSS by making use of the flexible design of data files.

Thus, when building the QCDSS there has been some consideration for each of the performance objectives a DSS should possess, in general.

Also, QCDSS combines data, model and dialog subsystems, in a manner to achieve an integration which is most appropriate to the problem, the decision-maker's understanding of the problem and the decision environment.

4.2. THE EVALUATION OF QCDSS

The evaluation of a DSS is a difficult task because the cost/benefit analysis approach which deals primarily with those benefits which can be quantified, is not sufficient. Both the "soft" qualitative benefits and the "hard" payoffs should be considered(38).

Qualitative benefits result from investigating more alternatives, doing more sophisticated analysis of alternatives, using better methods of comparing alternatives making quicker decisions and so on. Often it is difficult to identify the added value by the DSS, because it does not occur in a routine basis. Measuring added value is complicated by the difficulty of linking increased profits or other monetary measures to a change in the decision-making process(24).

Some possible measures that can be used in evaulating the impact of DSS are listed below. These are divided into four categories(9):

(i) Productivity Measures - These are used to evaluate the impact of DSS on decisions:

- Time to reach a decision
- Cost of making a decision
- Results of the decision
- Cost of implementing the decision

(ii) Process Measures - These are used to evaluate the impact of DSS on decision making:

- Number of alternatives examined
- Number of analyses done
- Number of participants in the decision making
- Time horizon of the decision
- Amount of data used
- Time spent in each phase of decision making

(iii) Perception Measures - These are used to evaluate the impact of DSS on decision makers:

- Control of the decision making process
- Usefulness of the DSS
- Ease of use
- Understanding of the problem
- Ease of "selling" the decision
- Conviction that the decision is correct.

(iv) Product Measures - These are used to evaluate the technical merits of the DSS:

- Response time
- Availability
- Mean time to failure
- Development costs

- Operating costs
- Maintenance costs
- Education costs
- Data acquisition costs.

A valid evaluation of QCDSS can be made only after its implementation. Nevertheless, a few points can be stated here:

(i) At each phase of decision a large number of alternatives are offered to the user and a large amount of data is made available to him. These characteristics are expected to improve the quality of decisions.

(ii) The control of the decision-making process is at the user, he can do as many number of experiments as he wishes to. These features are hoped to help the user to improve his understanding of the problem.

(iii) The system is easy to use, there are no pre-requisites for the user. Furthermore possibility of error is tried to be reduced to minimum.

(iv) The operating cost of QCDSS will be insignificant because it imposes no additional data and personnel requirements.

4.3. POSSIBLE EXTENSIONS TO QCDSS

A DSS is said to be never complete. QCDSS, not implemented yet, is at the initial iteration of its iterative design procedure. So, many possible extensions to it can be thought of. A few of them will be mentioned here.

A model to support the cause investigation step of the intelligence phase may be the next thing to add to QCDSS.

This will be a statistical model, containing ANOVA type of techniques to be used in determining the significance of various possible causes of the problem such as machines, shifts or material.

A second extension may be the embedding of a control chart application into the data base management software. This will increase the control and knowledge on the existing system and thus increase intelligence capabilities of QCDSS. Such an extension will not require much work since the relavant data is already available.

Another extension can be adding graphical capabilities to QCDSS. Thus the dialog subsystem will be enriched and the user's perception of the system will be increased.

Lastly, by increasing the report generating capability of QCDSS, its data base can be used with management information purposes, in obtaining regular reports to various departments (See Section 2.4). These multi-purpose usage opportunities will increase the benefits obtained from the system, making it more cost effective.

APPENDIX A

TABLES AVAILABLE IN FAILURE ANALYSIS MODULE

Here, available table types in all six analysis levels of Failure Analysis will be presented. On each table type there are a number of items that should be specified by the user and these are indicated by the letters "u.s." corresponding to "user specified".

ANALYSIS LEVEL I: GENERAL

a) TABLE 1: For the Overall Period

Displays a summary of information for the overall of a period specified by the decision-maker where the quality performance of product groups can be compared to each other.

ANALYSIS LEVEL : GENERAL
PERIOD : u.s. (i.e. 01/01/84-31/03/84)

Product Group	Produced Amount	Inspected Amount	Total Defectives	Scrap	Rework	Cost (TL)	Defective Perc. (%)	Cost Weight %
Incand	---	---						
Flour.	---							
Mer.Vap.								

b) TABLE 2: Time-Series

The performance on product-groups can be examined on time scale. The period chosen by the user is divided into intervals of length specified by him and either defective percentages or the cost weights are displayed. Also, the averages of all intervals are given.

ANALYSIS LEVEL : GENERAL
PERIOD : u.s.
INTERVAL LENGTH: u.s. (week, month or quarter)
CONTENT : u.s. (defective percentage or cost weight)

Product Group	Interval 1	Interval 2	.....	Average
Incand.				
Flour.				
Mer.Vap.				

ANALYSIS LEVEL II: PRODUCT GROUP

a) TABLE 1: For the Overall Period

All information for the lamp types belonging to the product group the user specifies is summarized for the given period. The table may be designed such that it includes all machine groups or only specified one(s).

PRODUCT GROUP : u.s. (i.e. Incandescent)
PERIOD : u.s.
MACHINE GROUP : u.s. (i.e. all)

Lamp Type	Produced Amount	Inspected Amount	Total Defectives	Scrap	Rework	Cost(₤)	Defective Perc. (%)	Cost Weight(%)
15 W	---	---						
25 W	---							
⋮								
TOTAL	---							

b) TABLE 2: Time-Series

The table displays the desired percentage type in all intervals of the chosen period for each lamp type belonging to the specified product group.

PRODUCT GROUP : u.s.
PERIOD : u.s.
INTERVAL LENGTH: u.s.
CONTENT : u.s. TOTAL PRODUCTION =
MACHINE GROUP : u.s. (i.e. Machine A) INSPECTED AMOUNT =

Lamp Type	Interval 1	Interval 2	.....	Average
15 W				
25 W				
⋮				

ANALYSIS LEVEL III: LAMP TYPE

a) TABLE 1: For the Overall Period

Shows the quality performance of a particular lamp type in a particular product group at each of the control stations, in a certain period. The table may aggregate all machine groups or it may be designed for specific machine groups only.

LAMP TYPE : u.s. (i.e., Incandescent 15 W)
PERIOD : u.s.
MACHINE GROUP : u.s.

Control Station	Produced Amount	Inspected Amount	Total Defectives	Scrap	Rework	Cost (TL)	Defective Perc. (%)	Cost Weight(%)
Mounting	---	---						
Finishing	---							

b) TABLE 2: Time-Series

Displays the changes in the quality performance of a particular lamp type in time, at each of the control stations in terms of defective percentage or cost weight.

LAMP TYPE : u.s.
PERIOD : u.s.
INTERVAL LENGTH : u.s.
CONTENT : u.s. TOTAL PRODUCTION =
MACHINE GROUP : u.s. INSPECTED AMOUNT =

Control Station	Interval 1	Interval 2	.....	Average
Mounting				
Finishing				
⋮				

ANALYSIS LEVEL IV: CONTROL STATION

a) TABLE 1A: For The Overall Period-With Respect To Machine Group

Displays the aggregate information for a specific control station with respect to the machine groups.

PRODUCT GROUP : u.s.
CONTROL STATION : u.s. (i.e. mounting control)
PERIOD : u.s.

Machine Group	Produced Amount	Inspected Amount	Total Defectives	Scrap	Rework	Cost (TL)	Defective Perc. (%)	Cost Weight(%)
A	---	---						
B	---							
:								
TOTAL	---							

b) TABLE 1B: For The Overall Period-With Respect To Lamp Type

Displays the aggregate information in the chosen period for a specific control station with respect to the lamp types controlled at that station. Machine group can be specified if desired.

PRODUCT GROUP : u.s.
CONTROL STATION : u.s.
PERIOD : u.s.
MACHINE GROUP : u.s.

Lamp Type	Produced Amount	Inspected Amount	Total Defectives	Scrap	Rework	Cost (TL)	Defective Perc. (%)	Cost Weight(%)
15 W	---	---						
25 W	---							
:								
TOTAL	---							

c) TABLE 2A: Time-Series-With Respect To Machine Group

For a particular control station, displays the chosen percentage type in all intervals of the specified period for each of the machine groups.

PRODUCT GROUP : u.s.
CONTROL STATION : u.s.
PERIOD : u.s.
INTERVAL LENGTH : u.s. TOTAL PRODUCTION =
CONTENT : u.s. INSPECTED AMOUNT =

Machine Group	Interval 1	Interval 2	.....	Average
A	----	----		
B	----			
⋮				

d) TABLE 2B: Time-Series-With Respect to Lamp Type

For a particular control station, displays the chosen percentage type in all intervals of the specified period for each of the lamp types controlled at that station.

PRODUCT GROUP : u.s.
CONTROL STATION : u.s.
PERIOD : u.s.
INTERVAL LENGTH : u.s.
CONTENT : u.s. TOTAL PRODUCTION =
MACHINE GROUP : u.s. INSPECTED AMOUNT =

Lamp Type	Interval 1	Interval 2	.....	Average
15 W				
25 W				
⋮				

ANALYSIS LEVEL V: CONTROL STATION/LAMP TYPE

a) TABLE 1: Time-Series

For each interval in the specified period information on the specified control station/lamp type combination is displayed. In the "First Three Defects" section, the defective percentages for the first three defects whose cost weights in the overall period are largest, are given.

PRODUCT GROUP : u.s.
CONTROL STATION : u.s.
LAMP TYPE : u.s.
MACHINE GROUP : u.s. (i.e., all or Machine A, etc.)
PERIOD : u.s.
INTERVAL LENGTH : u.s. TOTAL PRODUCTION = ---

Interval	Inspected Amount	Total Defectives	Defective Perc. (%)	Cost (TL)	- THE FIRST THREE DEFECTS - Code 1	Code 2	Code 3
1st Week	---	---					
2nd Week	---						
:							
TOTAL	---						

b) TABLE 2: For First Five Defects

Detailed information on the first five defects whose cost weights are the largest among all those observed in the specified period are displayed for a particular control station/lamp type combination. "Related Operation" gives the origin of the defect.

PRODUCT GROUP : u.s.
CONTROL STATION : u.s.
LAMP TYPE : u.s.
MACHINE GROUP : u.s. TOTAL PRODUCTION = ---
PERIOD : u.s. INSPECTED AMOUNT = ---

Defect Code	Defect Description	Related Operation	Quantity	Defective Perc. (%)	Cost Weight (%)	Cumulative Weight (%)
---	---	---				
---	---					

ANALYSIS LEVEL VI: CONTROL STATION/MACHINE GROUP

a) TABLE 1: Time-Series

For each interval in the specified period information on the specified control station/machine group combination is displayed. In the "The First Three Defects" section, the defective percentages for the first three defects whose cost weights are the largest in the overall period are given.

PRODUCT GROUP : u.s.
CONTROL STATION : u.s.
MACHINE GROUP : u.s.
PERIOD : u.s.
INTERVAL LENGTH : u.s. TOTAL PRODUCTION = ---

Interval	Inspected Amount	Total Defectives	Defective Perc. (%)	Cost (TL)	- THE FIRST THREE DEFECTS - Code 1	Code 2	Code 3
---	---	---					
---	---						
TOTAL	---						

b) TABLE 2: For First Five Defects

Detailed information on the first five defects whose cost weights are the largest among all those observed in the specified period are displayed for a particular control station/machine group combination. "Related Operation" gives the origin of the defect.

PRODUCT GROUP : u.s.
CONTROL STATION : u.s.
MACHINE GROUP : u.s. TOTAL PRODUCTION = ---
PERIOD : u.s. INSPECTED AMOUNT = ---

Defect Code	Defect Description	Related Operation	Quantity	Cost (TL)	Defective Perc. (%)	Cost Weight (%)	Cumulative Weight (%)
---	---	---					
---	---						

APPENDIX B

NOTES ON PROGRAMMING ASPECTS

QCDSS has been designed on Commodore CBM 8065 micro computer with 5 1/4 - inch dual floppy disk drives CBM Model 8050 and bi-directional printer MPP-1361.

Commodore BASIC Version 4.0 has been used as the programming language and QCDSS has been programmed on 32 K CBM BASIC text area as a number of modules chained to each other through the Main Menu. The selected module is automatically loaded and run by the program.

Of these modules "Failure Analysis", "Revision of the Inspection Plan" and "Data Input" are documented in Appendices C, D and E, respectively.

APPENDIX C

LISTING OF THE COMPUTER PROGRAM FOR FAILURE ANALYSIS MODULE

Here, the main body of the Failure Analysis Module and the subprograms corresponding to Control Station and Control Station/Machine Group levels of analysis are being documented.

```
eady.

1 dopen#1,"today",d0 : input#1,td$ :dclose#1
2 if td$="0" goto 4700
3 clr : bs=4
5 dim mg$(1,4) ,kn$(1,2),dt$(20),ay$(12),w%(20),bb$(7),h2$(6),h3$(6)
6 dim h$(20,2),hz(7,8),kz(7,8),pc(7,8),cz(7,8),tm(7),wt$(7)
7 dim ur(7),fr(7),dz(7),p2(7),avg(7),mak%(4),nm(1),nk(1),ng(1),n(1)
8 cr$=chr$(13)                                  : rem   carrige return
9 sp$="                                  "+"" : rem  bos luk doldurma
20 b1$="DONEM GENELINDE":b2$="ZAMANA BAGLI":b3$="ILK ON HATA ICIN"
21 rem *****        sutun basliklari                                    *****
22 h$(5,2)=left$(sp$,7) :h$(6,2)=h$(5,2)
23 h$(7,2)=h$(5,2)       :h$(15,2)=h$(5,2)
24 h$(17,2)=h$(5,2) :h$(20,2)=h$(5,2) :h$(19,2)=h$(5,2)
26 h$(1,1)="urun    " :h$(1,2)="grubu   " :h$(2,1)="uretim "
27 h$(2,2)="miktari":h$(4,2)="sayisi "
28 h$(3,1)="kontrol":h$(3,2)="edilen ":h$(4,1)="hatali "
30 h$(5,1)="iskarta":h$(6,1)="tamir   " :h$(8,1)="hatali "
31 h$(7,1)="maliyet":h$(8,1)="yuzdesi" :h$(10,2)="yuzde   "
32 h$(9,1)="parasal":h$(9,2)="agirlik":h$(10,1)="biriken"
34 h$(11,1)="kont.  ":h$(11,2)="noktasi":h$(12,1)="ht.     "
36 h$(13,1)="hata    ":h$(13,2)="tanimi ":h$(14,1)="ampul   "
37 h$(12,2)="kodu    " :h$(14,2)="cinsi   "
38 h$(15,1)="miktar ":h$(16,1)="ilgili ":h$(16,2)="islem   "
40 h$(17,1)="devre   " :h$(20,1)="p-bar   ":h$(19,1)="makina "
42 rem   *****       tablo sutunlari aciklamalari                        *****
43 hc$="(yuzdelerden biri ve bir zaman birimi secilecektir)"
44 h1$="(uretim,numune,hatali,iskarta,tamir,maliyet,yuzdeler)"
45 bb$(1)="URUN GRUBUNA GORE " : bb$(2)="AMPUL CINSINE GORE "
46 bb$(3)="KONTROL NOKTASINA GORE ": bb$(4)="MAKINA GRUBUNA GORE "
47 h2$(1)=hc$ : h2$(2)=hc$ : h2$(3)=hc$ : h2$(4)=hc$
48 h2$(5)="(devre,numune,hatali sayisi,yuzdesi,maliyet,ilk 3 hata)"
49 h3$(5)="(ht.kodu,tanimi,ilgili islem,miktar,maliyet,yuzdeler) "
50 h3$(6)=h3$(5)
51 bb$(7)=bb$(2)
52 h1$(5)=h1$(2)
53 h2$(6)=h2$(5)
55 ay$(1)=" ocak ": ay$(2)=" subat": ay$(3)=" mart ": ay$(4)=" nisan
56 ay$(5)=" mayis": ay$(6)=" haz. ": ay$(7)="temmuz": ay$(8)=" agus.
57 ay$(9)=" eylul":ay$(10)=" ekim ":ay$(11)=" kasim":ay$(12)="aralik
58 wt$(1)="15 W":wt$(2)="25 W":wt$(3)="40 W":wt$(4)="60 W"
59 wt$(5)="75 W": wt$(6)="100W" : wt$(7)="150W"
99 goto 7000
```

```
ready.

100 rem ************************************************************************
101 rem *              tanim dosyasini oku                                     *
102 rem ************************************************************************
110 dopen#2,"tanim/iml",d1
120 input#2,wi%
130 input#2,nu
140 for k=1 to nu
150 input#2,ug$(k): input#2,ng(k): input#2,wn%(k)
160 next k
180 for k=1 to nu
182 input#2,nm(k)
184 for j=1 to nm(k)
186 input#2,mg$(k,j)
188 next j
190 input#2,nk(k)
192 for j=1 to nk(k)
194 input#2,kn$(k,j)
196 next j
197 next k
198 dclose#2
210 for k=1 to nu
220 n(k)=nm(k)* nk(k)
230 next
240 return
```

eady.

```
300 rem ************************************************************************
301 rem *              tarihleri  oku                                            *
302 rem ************************************************************************
305 if ng(i)=0 goto 390
310 dopen#1,(fi$),d1
315 cr=0
320 for k=1 to ng(i)
330 for j=1 to n(i)
335 cr=cr+1
340 record#1,(cr),1 :input#1,w%(k)
350 record#1,(cr),6 :input#1,dt$(k)
360 next j
370 next k
380 dclose#1
382 t1$=left$(dt$(1),2):t2$=mid$(dt$(1),3,2):t3$=right$(dt$(1),2)
384 first$(i)=t3$+"/"+t2$+"/"+t1$
386 t1$=left$(dt$(ng(i)),2)  :t2$=mid$(dt$(ng(i)),3,2)
388 t3$=right$(dt$(ng(i)),2) :last$(i)=t3$+"/"+t2$+"/"+t1$
390 return
400 rem ************************************************************************
401 rem *            analiz doneminin belirlenmesi                               *
402 rem ************************************************************************
404 print "■■■■■" tab(5);
405 print "A n a l i z   d o n e m i n i   b e l i r l e y i n i z"
406 print:  if zb=0 then print:  goto409
407 print tab(5) ;
408 print"■ Devre : ";d$;"■-Donem  'en cok  8  devre' yi kapsamalidir
409 print tab(14)"■1. Son  -- hafta"
410 print tab(14)"2. Yilbasindan itibaren"
412 print tab(14)"3. Donembasi ve sonu ayrica belirlenecek"
418 print"■■■■■"tab(65); :input ad
425 on ad goto 430,450,470
430 print"■■■":print tab(20);:input a$ : print"■■■■" :rem ***********
432 a$=left$(a$,2) : a=val(a$) :ih=wn%(i)-a+1
434 ld=ng(i) : lr=ng(i)*n(i) : if zb=1 then d=a :if d>8  goto 490
436 d2$=dt$(ng(i)) : g2$=last$(i)
438 if wi%<= ih and ih<=wn%(i) goto447
440 print tab(5)"Donembasi bu veri disketinde yer almamaktadir"
441 print tab(5) ih ;
442 print " no.lu haftayi iceren disketi drive 1'e yerlestiriniz"
444 print:printtab(5);:input"Devam edebilir miyiz ( e/h )";c$
445 if c$<>"e" then print"■■";:goto 444
446 gosub 100:gosub 300:chg=1:  goto 438
447 gosub 900 :if zb>1 then  gosub 1400: if err goto 404
449 return                          :rem ***********************************
450 ld=ng(i): lr=ng(i)*n(i)  :print "■■■■■■■■"
452 d2$=dt$(ng(i)) :g2$=last$(i)
453 if zb=1 and wn%(i)>8 then d=wn%(i):goto 490
454 if wi%=1 goto 465
```

```
456 printtab(5)"Yilbasi bu veri disketinde yer almamaktadir"
458 printtab(5)"Ilgili disketi drive 1'e yerlestiriniz"
460 print :print tab(5);:input"Devam edebilir miyiz ( e/h )";c$
462 if c$<>"e" then print"■■";:goto460
464 gosub 100: gosub 300 : chg=1 : goto 454
465 fd=1 : fr=1 : ih=1
466 d1$=dt$(1) : g1$=first$(i)
467 if zb>1 then gosub 1400 :if err goto 490
468 if zb=1 then gosub 640: if err goto 490
469 return                              :rem ***********************************
470 print "■■■■■■■■■"
472 gosub 500
475 return                              :rem ***********************************
490 print"■"tab(5)"! Sectiginiz donem ";d;" devredir " :goto 404
500 rem ********************************************************************
501 rem *           donembasi - donemsonu                                    *
502 rem ********************************************************************
510 gosub 650
530 if c$<>"e" goto 560
540 input "      Devam edebilir miyiz (evet)";y$
550 gosub 100: gosub 300:print"■":goto 510
560 print
570 input "            Donembasi (gun,ay,yil) ";t1$,t2$,t3$
572 if len(t1$)<>2 or len(t2$)<>2 or len(t3$)<>2 goto 622
574 if t1$>"31" or t2$>"12" goto 622
580 d1$=t3$+t2$+t1$ : g1$=t1$+"/"+t2$+"/"+t3$
585 if d1$<dt$(1) or d1$>dt$(ng(i)) goto 622
590 input "            Donemsonu (gun,ay,yil) ";t4$,t5$,t6$
592 if len(t4$)<>2 or len(t5$)<>2 or len(t6$)<>2 goto 624
594 if t4$>"31" or t5$>"12" goto 624
600 d2$=t6$+t5$+t4$ : g2$=t4$+"/"+t5$+"/"+t6$
610 if d1$<d2$ goto 625
620 print "! HATALI","■■■": goto 570
622 print "! HATALI","■■": goto 570
624 print "! HATALI","■■" : goto 590
625 print "         ":if d2$>dt$(ng(i)) then chg=1
630 if zb>1 then gosub 1400 : if err goto 637
632 gosub 700
634 if zb=1  then gosub 640 : if err goto 637
635 return
636 d=d+1: tg$=right$(dt$(ld),2) : gg=val(tg$)
637 print"■";"DIKKAT : ";g1$;"-";g2$;"  donemi";d;" devredir."
638 printtab(5)"Devre uzunlugu:";"■";d$,"Donem ";"■en cok 8 devre";
639 print "■olmalidir" : goto 510
640 err=0: d=w%(ld)-w%(fd)+1 :if chg=0 goto 648 : rem **************
642 d=d+1: tg$=right$(dt$(ld),2) : gg=val(tg$)
644 gg=gg+7
646 if gg>30 then gg=gg-30  : mg=val(t2$)+1
647 if val(t4$)>gg and val(t5$)>=mg  then d=d+1  :goto 644
648 if d>8 then err=1
649 return
```

```
eady.

550 rem ***        disket kontrolu          ******************************
570 print tab(11)"Veri disketinde (drive:1)     ";
571 print "■";first$(i);"-";last$(i)
575 printtab(11)"tarihlerine ait bilgiler yer almaktadir","■"
579 print tab(11);
580 print "Incelemek istediginiz donemin basi bu tarihlerin arasina"
585 printtab(11)"dusmuyorsa ilgili disketi takiniz.":print"■"tab(11);
590 input "Disket degistirmek istiyor musunuz (e / h)";c$
595 return
700 rem ***************************************************************
701 rem *        belirtilen donemle ilgili kayitlarin saptanmasi      *
702 rem ***************************************************************
710 for j=1 to ng(i)
720 if d1$>dt$(j) goto 795
730 fd=j: fr=(j-1)*n(i)+1 : ih=w%(j)
740 if chg=0 goto 760
750 ld=ng(i) :lr=ng(i)*n(i) :return
760 for k=j to ng(i)
770 if d2$>dt$(k) goto 790
775 if d2$<>dt$(k) then k=k-1
780 ld=k : lr=k*n(i) : return
790 next k
795 next j
800 rem ***************************************************************
801 rem *          hesaplama sirasinda disket degistirilmesi          *
802 rem ***************************************************************
805 sn$ = dt$(ng(i))
810 print "■":print
812 print"Hesaplamanin surebilmesi icin veri disketini degistiriniz."
814 print "* ";last$(i);" tarihini takip eden disketi  drive 0 'ya";
816 print "  yerlestiriniz." : print : print
820 input " Devam edebilir miyiz (evet)";c$
830 gosub 100 : gosub 300
840 if dt$(1)<sn$ or dt$(1)>d2$ goto 880
850 t1$=left$(dt$(1),2):t2$=mid$(dt$(1),3,2):t3$=right$(dt$(1),2)
852 first$(i)=t3$+"/"+t2$+"/"+t1$
854 t1$=left$(dt$(ng(i)),2) :t2$=mid$(dt$(ng(i)),3,2)
856 t3$=right$(dt$(ng(i)),2): last$(i)=t3$+"/"+t2$+"/"+t1$
860 if d2$<=dt$(ng(i)) then chg=0
870 gosub 700  : if zb=1 then gosub 950
875 return
880 print "■"
882 print"DIKKAT - Yerlestirdiginiz disketi kontrol ediniz !":print
890 goto 812
```

```
ready.

900 rem ************************************************************
901 rem *              donemin ilk haftasinin tarihi                 *
902 rem ************************************************************
905 for j=1 to ng(i)
910 if ih=w%(j) goto920
915 next
920 fd=j : fr=(j-1)*n(i)+1
930 d1$=dt$(j) : g1$=right$(d1$,2)+"/"+mid$(d1$,3,2)+"/"+left$(d1$,2)
940 return
950 rem ************************************************************
951 rem *             haftalik tabloda devre sonlari                 *
952 rem ************************************************************
960 for j=fd to ld-1
970 if w%(j)=w%(j+1) goto 980
975 dn=dn+1:ds$(dn)=dt$(j)
977 if dn=d goto 990
980 next
985 ds$(dn+1)=dt$(j)
990 return
1000 rem ***********************************************************
1001 rem *               makina grubu secimi                         *
1002 rem ***********************************************************
1005 print :j=1
1010 print"* Hangi MAKINA GRUPLARI icin "
1020 print"  (Sonuncudan sonra  veya  tum gruplar icin ise  ";
1025 print"( - )  yaziniz)"
1030 print"■■"  : p=30
1040 print"■";tab(p); : input xx$
1045 if xx$="-" goto 1075
1050 for mg=1 to nm(i)
1055 if xx$=mg$(i,mg) goto  1070
1060 next
1065 print "■! Hatali";"■":goto1040
1070 mak%(j)=mg :j=j+1 : p=p+7 : goto1040
1075 mn=j-1 : if mn>0 then return
1080 mn=nm(i)
1085 for k=1 to mn : mak%(k)=k :next k
1090 return
```

```
ady.

100 rem ***************************************************************************
101 rem *                    tablo  secimi                                        *
102 rem ***************************************************************************
120 print " TABLO : Belirli  bir  donem  icin ";"■"
130 z$="1.": if bs=6 or bs=5 goto 1152
135 t=bs
140 print tab(9) z$+bb$(t)+b1$
145 print tab(12) h1$ :print :z$="2."
150 if bs=4 and t=bs then t=t+3 :goto1140
152 t=bs : if bs=4 then z$="3."
155 print tab(9) z$+bb$(t)+b2$
160 print tab(12) h2$(bs) :print :z$="4."
162 if bs=4 and t=bs then t=t+3 :goto1155
165 if bs<>5 and bs<>6 goto 1185
170 z$="2."
175 print tab(9) z$+b3$
180 print tab(12) h3$(bs) :print
185 input "* Istediginiz tablo tipini belirtiniz   ";y
186 if y<=4 goto 1190
188 print "! Hatali";"■■" : goto 1185
190 print "          " : if y<=2 then  d$=""
195 return
200 rem  ***************************************************************************
201 rem *              tablo sonu menusu                                            *
202 rem  ***************************************************************************
210 gosub 1241
220 print " Y : Yaz , D : Degistir , A : Ana menu ="
225 gosub 1241
228 print"■■"tab(42); : input e$
230 if e$="d" or  e$="y" or e$="a" then print : return
240 print "! Hatali";"■■": goto 1220
241 for j=1 to 80                : rem  ***   cizgi   ***
242 print "=";
243 next j
245 return
250 rem ***************************************************************************
251 rem *              tablo degistirme menusu                                      *
252 rem ***************************************************************************
255 print "* Yapilacak  degisikligi  belirtiniz ="
260 print"  1) Kont.noktasi    2) Tablo tipi    3) Donem    ";
264 if yz=0 and mn<>0 then print"4) Makina grubu";  : goto 1269
266 if yz>0 then print"4) Yuzde    ";
268 if mn<>0 then print"5) Mak.grubu"  ;
269 print"■■"
270 print tab(40);: input dg
275 if dg<=5 goto 1285
280 print "■■" : goto 1270
285 return
```

```
ready.

 1300 rem ************************************************************
 1301 rem *                    yuzdeler                                *
 1302 rem ************************************************************
 1305 print
 1310 print "* Tabloda istenilen yuzdeyi belirtiniz : "
 1315 print
 1320 print "1.  hatali yuzdesi(%) = ( hatali / kont.edilen ) * 100"
 1321 print
 1325 print"2.  parasal agirlik(%) = ( maliyet / toplam maliyet) * 10
 1330 print "■■■■■■";
 1335 print tab(40); : input yz
 1340 if yz=1 or yz=2 then return
 1345 print "! Hatali","■■": goto 1335
 1350 rem ************************************************************
 1351 rem *                    zaman birimi secimi                     *
 1352 rem ************************************************************
 1355 print"■■■■■■■■■■"
 1360 print       tab(25)"* Zaman  birimini  seciniz :"
 1365 print
 1370 print tab(21)  "1)  hafta        2)  ay          3)  3 ay"
 1375 print "■■■■"  ;
 1380 print tab(55); : input zb
 1385 if zb=1 or zb=2 or zb=3 then return
 1390 print "! Hatali","■■" : goto 1380
 1400 rem ************************************************************
 1401 rem *        zamana bagli tabloda devre belirlenmesi           *
 1402 rem ************************************************************
 1404 g=1  : err=0
 1405 t1$=right$(d1$,2) :t2$=mid$(d1$,3,2) : t3$=left$(d1$,2)
 1410 t4$=right$(d2$,2) :t5$=mid$(d2$,3,2) : t6$=left$(d2$,2)
 1412 if t3$=t6$ goto 1420
 1414 if val(t3$)+1 = val(t6$) then g=g+12
 1418 if zb=2 goto 1440
 1420 if zb=3 goto 1450
 1440 d=val(t5$)-val(t2$)+g   : goto 1454
 1450 d=(val(t5$)-val(t2$)+g)/3  : if d>=1 goto 1453
 1452 d=0 : goto 1455
 1453 d=int(d+0.9)
 1454 if d<=8 and d>0 then return
 1455 err=1 : return
 1500 rem ************************************************************
 1501 rem *        zamana bagli tabloda devre sonlari                *
 1502 rem ************************************************************
 1505 t3$=right$(d1$,2) : t1$=left$(d1$,2) : t2$=mid$(d1$,3,2)
 1507 if zb=1 goto 1590
 1510 for j=1 to d
 1520 if zb=2 goto 1555
 1525 m=val(t2$)+2 : t2$=right$(sp$+str$(m),2)
```

```
530 if m<=12 goto 1555
535 m=m-12 :t2$=right$(sp$+str$(m),2)
536 mm=val(t1$)+1   :t1$=right$(sp$+str$(mm),2)
555 ds$(j)=t1$+t2$+"31"
560 t3$="01" : m=val(t2$)+1 : t2$=right$(sp$+str$(m),2)
565 if m<=12 goto 1575
570 t2$="01" : mm=val(t1$)+1 : t1$=right$(sp$+str$(mm),2)
575 next j
580 return
590 dn=0 :gosub 950: return
600 rem ************************************************************
601 rem *                          ortalama                        *
602 rem ************************************************************
605 s1=0
610 for j=1 to d
615 s1=s1+pc(k,j)
620 next j
625 avg(k)=s1/d  : avg(k)=int((avg(k)+0.005)*100)/100.0
630 return

ady.

500 print"■":print
510 print"************************************************************"
515 print"*                                                          *"
520 print"*  ********************************************************  *"
522 print"*  *                                                      *  *"
524 print"*  *                 * K K K D S *                        *  *"
526 print"*  *    H A T A  A N A L I Z I  P R O G R A M I           *  *"
528 print"*  *                                                      *  *"
530 print"*  ********************************************************  *"
532 print"*                                                          *"
534 print"*                                                          *"
536 print"*   E n  s o n  v e r i  d i s k e t i n i                  *"
538 print"*   d r i v e : 1 ' e  y e r l e s t i r i n i z            *"
540 print"*                                                          *"
542 print"*                                                          *"
544 print"*   B u g u n u n  t a r i h i ( GG/AA/YY )                *"
546 print"*                                                          *"
548 print"*                                                          *"
550 print"************************************************************"
555 print" Bogazici Universitesi,Endustri Muhendisligi Bolumu,1984 "
560 print"■■■■■";tab(55);
562 input td$    : td$=left$(td$,8)
570 dopen#1,"@today",d0,w : print#1,td$ : dclose#1
```

ady.

```
600 print"■"
602 print"*****************************************************************"
604 print"*                                                               *"
606 print"*                                                               *"
608 print"*  ***********************************************************  *"
610 print"*  *                                                         *  *"
615 print"*  *                  * K K K D S *                          *  *"
620 print"*  *     H A T A   A N A L I Z I   P R O G R A M I           *  *"
625 print"*  *      A N A L I Z   D U Z E Y I   M E N U S U            *  *"
630 print"*  *                                                         *  *"
635 print"*  ***********************************************************  *"
640 print"*                                                               *"
645 print"*         <1>  G e n e l                                        *"
650 print"*         <2>  U r u n   g r u b u                              *"
652 print"*         <3>  A m p u l   c i n s i                            *"
654 print"*         <4>  K o n t r o l   n o k t a s i                    *"
656 print"*         <5>  K . n o k t a s i / A . c i n s i                *"
658 print"*         <6>  K . n o k t a s i / M a k i n e   g r u b u      *"
660 print"*         <7>  A n a l i z   s o n u                            *"
662 print"*                                                               *"
664 print"*         Analiz  duzeyini  belirtiniz                          *"
666 print"*                                                               *"
668 print"*****************************************************************"
670 print"■■■";tab(52);
675 input bs$ : bs$=left$(bs$,2) : bs=val(bs$)
680 on bs goto 5000,5100,5200,5400,5300,7000
685 if bs=7 goto 4700
690 print"! Hatali";"■";tab(52);:goto 4675
```

```
eady.

4700 print"■";
4702 print"*****************************************************************"
4704 print"*                                                               *"
4708 print"*  ***********************************************************  *"
4710 print"*  *                                                         *  *"
4715 print"*  *                  * K K K D S *                          *  *"
4720 print"*  *      K A L I T E   K O N T R O L   K A R A R            *  *"
4725 print"*  *           D E S T E K   S I S T E M I                   *  *"
4730 print"*  *                                                         *  *"
4735 print"*  ***********************************************************  *"
4742 print"*                                                               *"
4745 print"*        <1>  V e r i   E k l e n m e s i                       *"
4747 print"*                                                               *"
4750 print"*        <2>  H a t a   A n a l i z i                           *"
4751 print"*                                                               *"
4752 print"*        <3>  K K   P l a n i   Y e n i l e m e                 *"
4753 print"*                                                               *"
4754 print"*        <4>  K K   D e s t e k   D o s y a l a r i             *"
4755 print"*                                                               *"
4756 print"*        <5>  S o n                                             *"
4760 print"*                                                               *"
4764 print"*        Yapilacak  islemi  belirleyiniz                        *"
4766 print"*                                                               *"
4768 print"*****************************************************************"
4770 print" Bogazici Universitesi,Endustri Muhendisligi Bolumu,1984"
4772 print"■■■■■";tab(54);
4775 input  s$ :  s$=left$(s$,2) :  s=val(s$)
4780 on s goto 4800,4810,4820,4830,4840
4785 print"! Hatali";"■";tab(54); :goto 4775
4800 dload"veriekler",d0
4810 dload"hata analizi",d0
4820 dload"kk plani",d0
4830 dload"kk dosyalari",d0
4840 dopen#1,"@today",d0,w : print#1,"0" : dclose#1
4850 end
5000 dload"genel",d0
5100 dload"urun grubu",d0
5200 dload"ampul cinsi",d0
5300 dload"kon.nok/ac",d0
5400 dload"hata analizi",d0
```

```
ready.

 7000 rem ************************************************************
 7001 rem *            analiz duzeyi = kontrol noktasi
 7002 rem ************************************************************
 7003 gosub 100
 7005 print "■■■■■■■■■■"
 7010 print tab(20);: input " URUN GRUBU       :  ";x$
 7012 for i=1 to nu
 7014 if left$(x$,6)=left$(ug$(i),6) goto 7020
 7016 next i
 7018 print "! hatali";"■■"   : goto 7010
 7020 print tab(20);: input " KONTROL NOKTASI :  ";kn: print "■"
 7030 if kn<=nk(i) goto 7040
 7035 print "! hatali","■■■■": goto 7020
 7040 fl$=left$(ug$(i),6)+"/iml" : gosub 300
 7050 print"■■  URUN GRUBU :  ";ug$(i);"■KONTROL NOKTASI :";kn$(i,kn);
 7055 print"■      "
 7060 gosub 1100 : mn=0 :zb=0 :yz=0 :c=0 :ac$="" : vv$=""
 7070 on y goto 7100,7230,7500,7590
 7100 rem  **********     tablo 1     ************************************
 7105 gosub 1700 : if c$<>"e" goto 7142
 7110 print"■■  URUN GRUBU :  ";ug$(i);"■KONTROL NOKTASI : ";kn$(i,kn)
 7120 gosub 400                  :  rem  * donemin belirlenmesi *
 7142 th=0 : tu=0 : tk=0 : tf=0 : td=0 :tc=0
 7143 for j=1 to nm(i)
 7144 ur(j)=0: kz(1,j)=0: hz(1,j)=0: fr(j)=0 :dz(j)=0
 7145 pc(1,j)=0 : p2(j)=0 : cz(1,j)=0
 7146 next j
 7150 dopen#1,(fl$),d1                          : rem   * hesaplama *
 7160 for j=fd to ld             : rem     ilk gunden son gune
 7162 r=(j-1)*n(i)+kn            : rem     ilk makina
 7164 for k=1 to nm(i)
 7174 record#1,(r),25 : input#1,tp% : ur(k)=ur(k)+tp%
 7176 record#1,(r),33 : input#1,in% : kz(1,k)=kz(1,k)+in%
 7178 record#1,(r),40 : input#1,df% : hz(1,k)=hz(1,k)+df%
 7180 record#1,(r),46 : input#1,sc% : fr(k)=fr(k)+sc%
 7182 record#1,(r),52 : input#1,r%  : dz(k)=dz(k)+r%
 7183 record#1,(r),158 : input#1,ct% : cz(1,k)=cz(1,k)+ct%
 7184 th=th+df% :tu=tu+tp% :tk=tk+in%: tf=tf+sc%: td=td+r% :tc=tc+ct%
 7185 r=r+nk(i)
 7187 next k
 7190 next j
 7200 dclose#1
 7202 if chg=0 goto 7210
 7204 gosub 800 : goto 7150  : rem  (hesap sirasinda disket degisimi)
 7210 for j=1 to nm(i)
 7215 pc(1,j)=hz(1,j)/kz(1,j)*100 : p2(j)=cz(1,j)/tc*100
```

```
7216 pc(1,j)=int((pc(1,j)+0.005)*100)/100.0
7217 p2(j)=int((p2(j)+0.005)*100)/100.0
7220 next j
7225 ll=nm(i) : gosub 7700 : goto 7450
7230 gosub 1000                    : rem  * makina grubu secimi *
7232 gosub 1700 : if c$<>"e" goto 7242
7235 print"■ URUN GRUBU : ";ug$(i);"■ KONTROL NOKTASI :  ";kn$(i,kn)
7240 gosub 400
7242 th=0 : tu=0 : tk=0 : tf=0 : td=0 :tc=0
7243 for j=1 to 7
7244 ur(j)=0: kz(1,j)=0: hz(1,j)=0: fr(j)=0
7245 dz(j)=0: pc(1,j)=0: p2(j)=0:cz(1,j)=0
7246 next j
7250 dopen#1,(fl$),d1                          : rem   * hesaplama *
7252 for j=fd to ld              : rem     ilk gunden son gune
7254 f=(j-1)*n(i)
7256 for k=1 to mn
7258 r=f+(mak%(k)-1)*nk(i)+kn
7260 record#1,(r),13 : input#1,ac$
7262 gosub 8500
7264 record#1,(r),25 : input#1,tp% : ur(c)=ur(c)+tp%
7266 record#1,(r),33 : input#1,in% : kz(1,c)=kz(1,c)+in%
7268 record#1,(r),40 : input#1,df% : hz(1,c)=hz(1,c)+df%
7270 record#1,(r),46 : input#1,sc% : fr(c)=fr(c)+sc%
7272 record#1,(r),52 : input#1,r%  : dz(c)=dz(c)+r%
7274 record#1,(r),158 : input#1,ct% : cz(1,c)=cz(1,c)+ct%
7276 th=th+df% :tu=tu+tp% :tk=tk+in% :tf=tf+sc% :td=td+r% :tc=tc+ct%
7278 next k
7280 next j
7290 dclose#1
7292 if chg=0 goto 7300
7294 gosub 800 : goto 7250  : rem  (hesap sirasinda disket degisimi)
7300 for j=1 to 7
7305 if kz(1,j)=0 goto 7325
7310 pc(1,j)=hz(1,j)/kz(1,j)*100 : p2(j)=cz(1,j)/tc*100
7315 pc(1,j)=int((pc(1,j)+0.005)*100)/100.0
7320 p2(j)=int((p2(j)+0.005)*100)/100.0
7325 next j
7340 ll=7 : gosub 7700
7450 gosub 1200                          : rem   * tablo sonu menusu *
7455 if e$="a" goto 7999
7460 if e$="d" goto 7490
7465 open 7,4,7 : print#7 : close 7
7470 open 4,4
7475 cmd 4: gosub 7700
7480 print#4 : close 4
7485 print "■■■■":goto 7450
7490 gosub 1250                                  : rem   * degistir  *
7492 on dg goto 7005,7050,7494,7497
7494 if y=2 goto 7235
7495 goto 7110
7497 gosub 1000 : goto 7242
```

```
ready.

 7500 rem ***********     tablo  2      ********************************
 7510 print"■ URUN GRUBU : ";ug$(i);"■ KONTROL NOKTASI :  ";kn$(i,kn)
 7515 gosub 1300
 7517 gosub 1700 :if c$<>"e" goto 7540
 7518 print "■" : gosub 1350
 7520 if zb=1 then d$=" hafta "
 7522 if zb=2 then d$=" 1 ay  "
 7524 if zb=3 then d$=" 3 ay  "
 7526 print"■ URUN GRUBU : ";ug$(i);"■ KONTROL NOKTASI :  ";kn$(i,kn)
 7530 gosub 400                          : rem   * donem belirlenmesi *
 7535 gosub 1500                         : rem   * devre sonlari-ds$  *
 7540 jj=1
 7542 for k=1 to nm(i)
 7544 for j=1 to d
 7546 kz(k,j)=0 : hz(k,j)=0 : pc(k,j)=0 : cz(k,j)=0 : tm(j)=0
 7547 next j
 7548 avg(k)=0 : fct(k)=0
 7549 next k
 7550 dopen#1,(fl$),d1                   : rem   * hesaplama          *
 7555 for j=fd to ld                     : rem   * ilk gun-son gun    *
 7556 if dt$(j)>ds$(jj) then jj=jj+1
 7557 r=(j-1)*n(i)+kn
 7560 for k=1 to nm(i)                   : rem   * ilk makina-son makina *
 7562 if yz=2 goto 7567
 7564 record#1,(r),33 : input#1,in% : kz(k,jj)=kz(k,jj)+in%
 7566 record#1,(r),40 : input#1,df% : hz(k,jj)=hz(k,jj)+df%:goto 7569
 7567 record#1,(r),158: input#1,ct% : cz(k,jj)=cz(k,jj)+ct%
 7568 tm(jj)=tm(jj)+ct%
 7569 r=r+nk(i)
 7570 next k,j
 7571 dclose#1
 7572 if chg=0  goto 7574
 7573 gosub 800 : goto 7555              : rem   * disket degisimi    *
 7574 ll=nm(i) :gosub 8400
 7580 ll=nm(i)  : gosub 7700  :goto 7655 :rem   * ekranda tablo       *
 7590 gosub 1000                 : rem ** tablo 1b-makina grubu secimi **
 7592 print"■ URUN GRUBU : ";ug$(i);"■ KONTROL NOKTASI :  ";kn$(i,kn)
 7594 gosub 1300 : gosub 1700 : if c$<>"e" goto 7608
 7595 print "■" : gosub 1350
 7596 if zb=1 then d$=" hafta "
 7598 if zb=2 then d$=" 1 ay  "
 7599 if zb=3 then d$=" 3 ay  "
 7600 print"■ URUN GRUBU : ";ug$(i);"■ KONTROL NOKTASI :  ";kn$(i,kn)
 7602 gosub 400                          : rem   * donem belirlenmesi *
 7604 gosub 1500                         : rem   * devre sonlari-ds$  *
 7608 jj=1
 7610 for k=1 to 7
 7612 for j=1 to d
 7614 kz(k,j)=0 : hz(k,j)=0 : pc(k,j)=0 : cz(k,j)=0 : tm(j)=0
```

```
7616 next j
7618 avg(k)=0 : fct(k)=0
7619 next k
7620 dopen#1,(fl$),d1                    : rem   * hesaplama              *
7622 for j=fd to ld                      : rem   * ilk gun-son gun        *
7624 if dt$(j)>ds$(jj) then jj=jj+1      : rem   * devre degisimi         *
7626 f=(j-1)*n(i)
7628 for k=1 to mn                       : rem   * makina gruplari        *
7630 r=f+(mak%(k)-1)*nk(i)+kn
7632 record#1,(r),13 : input#1,ac$ : gosub 8500
7633 if yz=2 goto 7638
7634 record#1,(r),33 : input#1,in% : kz(c,jj)=kz(c,jj)+in%
7636 record#1,(r),40 : input#1,df% : hz(c,jj)=hz(c,jj)+df%:goto 7642
7638 record#1,(r),158: input#1,ct% : cz(c,jj)=cz(c,jj)+ct%
7640 tm(jj)=tm(jj)+ct%
7642 next k,j
7644 dclose#1
7646 if chg=0 goto 7650
7648 gosub 800 : goto 7620
7650 ll=7 : gosub 8400
7652 ll=7 : gosub 7700
7655 gosub 1200                          : rem   * tablo sonu menusu  *
7660 if e$="a" goto 7999
7665 if e$="d" goto 7690
7670 open 7,4,7 : print#7 : close 7      : rem   *     yaz            *
7675 open4,4 : cmd 4 : gosub 7700
7680 print#4 : close 4
7685 print "[illegible]" : goto 7655
7690 gosub 1250
7692 on dg goto 7005,7050,7693,7695,7699
7693 gosub 1350 :if y=3 goto 7520
7694 goto7596
7695 if yz=1 then yz=2 : goto 7697
7696 if yz=2 then yz=1
7697 if y=3 goto 7540
7698 goto 7608
7699 gosub 1000 : goto 7608
7700 rem *****    ekranda tablo olusturulmasi     ********************
7710 print"[illegible] URUN GRUBU :  ";ug$(i);" KONTROL NOKTASI :  ";kn$(i,kn)
7722 if mn=0 goto 7726
7723 print: print "   MAKINA GRUBU :  ";
7724 for k=1 to mn : print mg$(i,mak%(k));"    "; : next
7726 print : print "   DONEM          :  ";g1$;"-";g2$
7728 on y goto 7730,7730,7800,7800
7730 rem **********    tablo 1    ************************************
7731 print
7732 if y=1 then hs$(1)="makina "  :hs$(2)="grubu   " : goto 7740
7734 hs$(1)="ampul   "  :hs$(2)="cinsi   "
7740 for k=1 to 2
7745 print hs$(k);spc(2);h$(2,k);spc(2);h$(3,k);spc(2);h$(4,k);
```

```
7746 print spc(2);h$(5,k);spc(2);h$(6,k);spc(2);
7747 print h$(7,k);spc(2);h$(8,k);spc(2);h$(9,k)
7750 next k
7755 gosub 7780
7756 for k=1 to ll
7757 if y=1 then c1$=left$(mg$(i,k)+sp$,7) : s=9 : goto 7762
7761 c1$=left$(wt$(k)+sp$,7) : s=9
7762 c2$=right$(sp$+str$(ur(k)),s)
7763 c3$=right$(sp$+str$(kz(1,k)),s)
7764 c4$=right$(sp$+str$(hz(1,k)),s)
7765 c5$=right$(sp$+str$(fr(k)),s)
7766 c6$=right$(sp$+str$(dz(k)),s)
7767 c7$=right$(sp$+str$(cz(1,k)),s)
7768 c8$=right$(sp$+str$(pc(1,k)),s): c1$=c8$: gosub 7785 : c8$=c1$
7769 c9$=right$(sp$+str$(p2(k)),s)  : c1$=c9$: gosub 7785 : c9$=c1$
7770 print c1$;c2$;c3$;c4$;c5$;c6$;c7$;c8$;c9$
7771 next k
7772 print : gosub 7780
7773 print "Toplam ";right$(sp$+str$(tu),9);right$(sp$+str$(tk),9);
7774 print right$(sp$+str$(th),9);right$(sp$+str$(tf),9);
7775 print right$(sp$+str$(td),9);right$(sp$+str$(tc),9);
7779 print spc(6);"-  ";spc(3);"100.00":  print    : return
7780 for k=1 to 9                    :   rem   *   cizgi    *
7782 print "-------";spc(2);
7784 next k : print     :return
7785 if mid$(c1$,s-2,1)="." then return  : rem  * decimal point*
7786 if mid$(c1$,s-1,1)<>"." goto 7788
7787 c1$=right$(c1$+"0",s) :return
7788 c1$=right$(c1$+".00",s)
7790 return
7800 rem **********     tablo  2      **************************
7805 print"   DEVRELER     : ";d$
7810 if yz=2 goto 7840
7820 print"   ";" Hatali  yuzdesi  tablosu " : print
7830 goto 7842
7840 print"   ";" Parasal agirlik tablosu " : print
7842 s=8 : l=1: if d>5 goto 7846
7844 s=10 : l=3
7846 if y=3 then hs$(1)="makina ":hs$(2)="grubu  ":goto 7850
7848 hs$(1)="ampul  ":hs$(2)="cinsi  "
7850 on zb goto 7852,7878,7880
7852 print hs$(1);spc(l);
7854 hn=ih-1
7856 for k=1 to d
7858 hn=hn+1
7860 print left$(str$(hn)+"."+sp$,s);
7862 next k
7864 print : print hs$(2);spc(l);
7866 for k=1 to d
7868 print left$(" hafta"+spc$,s);
7870 next k
```

```
eady.

7872 print left$(" ort."+sp$,s)
7874 goto 7900
7878 k=1 : gosub 7940 : goto 7900
7880 print hs$(1);spc(l);
7882 t2$= mid$(d1$,3,2) : m=val(t2$)
7884 for k=1 to d
7886 print ay$(m) ;spc(l+1); : m=m+3 : if m>12 then m=m-12
7888 next k
7890 print : k=2 : gosub 7940
7900 gosub 7970
7910 for k=1 to ll
7911 if y=3 then print left$(mg$(i,k)+sp$,7);: goto7914
7912 print wt$(k);spc(3);
7914 for j=1 to d
7916 cl$=right$(sp$+str$(pc(k,j)),s) : gosub 7785 :  print cl$;
7918 next j
7920 cl$=right$(sp$+str$(avg(k)),s) : print cl$
7925 next k  : print : print
7930 return
7940 print hs$(k);spc(l);
7945 for j=1 to d
7950 t2$=mid$(ds$(k),3,2) : m=val(t2$)
7955 print ay$(m); spc(l+1);
7960 next j
7965 print " ort.  ";spc(l): return
7970 for j=1 to d+2                          : rem   *   cizgi        *
7975 print "--------";spc(l);
7980 next j : print : return
7999 goto 4600
8400 rem **********  tablo 2-yuzde,ortalama,tahmin ***************
8410 if yz=2 goto 8435                       : rem   * yuzdeler       *
8415 for k=1 to ll
8420 for j=1 to d
8422 if kz(k,j)=0 goto 8430
8425 pc(k,j)=hz(k,j)/kz(k,j)*100
8426 pc(k,j)= int((pc(k,j)+0.005)*100)/100.0
8430 next j,k   : goto 8455
8435 for k=1 to ll
8440 for j=1 to d
8442 if tm(j)=0 goto 8450
8445 pc(k,j)=cz(k,j)/tm(j)*100
8446 pc(k,j)= int((pc(k,j)+0.005)*100)/100.0
8450 next j,k
8455 for  k=1 to ll                          : rem   * ortalama       *
8460 gosub 1600
8465 next k
8485 return
```

eady.

```
8500 rem ********   ampul cinsinin belirlenmesi   ********************
8510 aa$=left$(ac$,3)   :if val(aa$)=0 then aa$=right$(aa$,2)
8515 if aa$="15" then c=1 : return
8520 if aa$="25" then c=2 : return
8525 if aa$="40" then c=3 : return
8530 if aa$="60" then c=4 : return
8535 if aa$="75" then c=5 : return
8540 if aa$="100" then c=6 : return
8545 c=7 :return
```

```
ready.

7000 rem ************************************************************************
7001 rem *       analiz duzeyi = kontrol noktasi / mak.grubu                    *
7002 rem ************************************************************************
7003 gosub 100
7005 print "■■■■■■■■■■"
7010 print tab(20);:input " URUN GRUBU       :  ";x$
7012 for i=1 to nu
7014 if left$(x$,6)=left$(ug$(i),6)  goto 7020
7016 next i
7018 print "! hatali";"■■"   : goto 7010
7020 f1$=left$(ug$(i),6)+"/iml" : gosub 300
7022 f2$=left$(ug$(i),6)+"/tl"
7024 print tab(20);:input " KONTROL NOKTASI :  ";kn
7025 if kn<=nk(i) goto 7028
7026 print "! hatali","■■"   :goto 7024
7028 kj=kn*2: f1$=left$(ug$(i),3)+"/"+str$(kj)+"/hata"
7030 gosub 8000
7035 print tab(20);:input " MAKINA GRUBU    :  ";xx$
7040 for mg=1 to nm(i)
7042 if xx$=mg$(i,mg) goto 7060
7044 next mg
7045 print "! Hatali ","■■"   : goto 7035
7060 print"■■  URUN GRUBU :  ";ug$(i);"■          KONTROL NOKTASI :  ";
7062 print "■"kn$(i,kn);"■       "
7065 print "■                        MAKINA GRUBU : ";mg$(i,mg);
7066 print "■                                      "
7070 gosub 1100 :zb=0 : vv$=""   : yy=0
7080 on y goto 7100,7400
7100 rem  **********     tablo 1     ***********************************
7101 gosub 1700 : if c$<>"e" goto 7122
7102 gosub 1350
7104 if zb=1 then d$=" hafta"
7106 if zb=2 then d$=" 1 ay "
7108 if zb=3 then d$=" 3 ay "
7110 print"■■  URUN GRUBU :  ";ug$(i);"■          KONTROL NOKTASI :  ";
7112 print "■"kn$(i,kn);"■       "
7115 print "■                        MAKINA GRUBU : ";mg$(i,mg);
7116 print "■                                      "
7120 gosub 400  : gosub 1500   :  rem  * donemin belirlenmesi *
7122 jj=1 : th=0 : tu=0 : tk=0 :tc=0 : ty=0
7124 for k=1 to d
7126 ke(k)=0:ht(k)=0:cs(k)=0
7128 for  j=1 to nh(kn) :   hq(j,k)=0 : next j
7130 next k
7131 for j=0 to 3
7132 b(j)=0 : tm(j)=0
7134 for k=1 to d : pc(j,k)=0   : next k
7136 next j
7138 for j=1 to nh(kn) : hm(j)=0: next
```

```
7140 dopen#1,(f1$),d1                              : rem    * hesaplama *
7142 dopen#2,(f2$),d1
7145 for j=fd to ld
7150 if dt$(j)>ds$(jj) then jj=jj+1
7155 r=(j-1)*n(i)+(mg-1)*nk(i)+kn
7160 record#1,(r),25 : input#1,tp% : tu=tu+tp%
7162 record#1,(r),33 : input#1,in% : ke(jj)=ke(jj)+in%
7164 record#1,(r),40 : input#1,df% : ht(jj)=ht(jj)+df%
7166 p=58 : q=1
7168 for k=1 to nh(kn)
7170 record#1,(r),(p): input#1,dq% : hq(k,jj)=hq(k,jj)+dq%
7172 record#2,(r),(q) : input#2,dc% : hm(k)=hm(k)+dc%
7174 p=p+5 : q=q+8
7176 next k
7178 record#1,(r),158 : input#1,ct% : cs(jj)=cs(jj)+ct%
7180 next j
7182 dclose#1
7183 dclose#2
7184 if chg=1 then gosub 800 : goto 7140
7185 for k=1 to d
7186 tc=tc+cs(k) : tk=tk+ke(k) : th=th+ht(k)
7188 pc(0,k)=ht(k)/ke(k)*100 :pc(0,k)=int((pc(0,k)+0.005)*100)/100
7190 next k
7192 for j=1 to 3
7194 max=0
7196 for k=1 to nh(kn)-1
7198 if k=b(1) or k=b(2) goto 7202
7200 if max<hm(k) then max=hm(k) : b(j)=k
7202 next k,j
7205 for j=1 to 3
7210 for k=1 to d
7212 pc(j,k)=hq(b(j),k)/ke(k)*100
7213 pc(j,k)=int((pc(j,k)+0.005)*100)/100
7214 tm(j)=tm(j)+hq(b(j),k)
7216 next k
7218 pc(j,d+1)=tm(j)/tk*100
7219 pc(j,d+1)=int((pc(j,d+1)+0.005)*100)/100
7220 nextj
7225 ty=th/tk*100       : ty=int((ty+0.005)*100)/100
7230 gosub 7700
7235 print"   DEVRE UZUNLUGU  : ";d$;"                    URETIM : ";tu
7236 print
7240 print"Devre  ";spc(7);"Kontrol";spc(2);"Hatali ";spc(2);"Hatali";
7242 printspc(2);"Maliyet";spc(2);"- Ilk uc hata'nin yuzdeleri -"
7244 printspc(14);"Edilen ";spc(2);"Sayisi ";spc(2);"Yuzdesi";spc(14);
7246 print kd$(b(1));spc(7);kd$(b(2));spc(7);kd$(b(3))
7250 gosub 7750   : hn=ih-1
7255 for j=1 to d
7260 on zb goto 7265,7270,7275
7265 hn=hn+1: dv$=str$(hn)+".hafta": dv$=left$(dv$+sp$,12) :goto 7280
```

```
7270 t2$=mid$(ds$(j),3,2) : m=val(t2$) :dv$=left$(ay$(m)+sp$,12)
7271 goto 7280
7275 t2$=mid$(ds$(j),3,2) : m=val(t2$):dv$=ay$(m-2)+"-"+ay$(m)
7280 c1$=right$(sp$+str$(ke(j)),9)
7282 c2$=right$(sp$+str$(ht(j)),9)
7284 c3$=right$(sp$+str$(pc(0,j)),9)
7286 c4$=right$(sp$+str$(cs(j)),9)
7288 c5$=right$(sp$+str$(pc(1,j)),9)
7290 c6$=right$(sp$+str$(pc(2,j)),10)
7292 c7$=right$(sp$+str$(pc(3,j)),10)
7294 print dv$;c1$;c2$;c3$;c4$;c5$;c6$;c7$
7296 next j
7300 gosub 7750
7310 print "Toplam      ";right$(sp$+str$(tk),9);
7311 print right$(sp$+str$(th),9);
7312 print right$(sp$+str$(ty),9);right$(sp$+str$(tc),9);
7314 print right$(sp$+str$(pc(1,d+1)),9);
7315 print right$(sp$+str$(pc(2,d+1)),10);
7316 print right$(sp$+str$(pc(3,d+1)),10)
7317 print
7318 if yy=1 then print#4:close4 : yy=0 : print"■■■■"
7320 gosub 1200
7325 if e$="a" goto 4600
7330 if e$="d" goto 7345
7335 open 7,4,7 : print#7 : close 7
7340 open 4,4 : cmd4: yy=1 : goto 7230
7345 gosub 1250
7348 print"■■■■■■■■■"
7350 on dg goto 7020,7070,7102
```

```
eady.

7400 rem *****                    tablo 2          **********************
7405 gosub 1700:if c$<>"e" goto 7422
7410 print"■■  URUN GRUBU :  ";ug$(i);"■          KONTROL NOKTASI :  ";
7412 print "■"kn$(i,kn);"■      "
7415 print "■                          MAKINA GRUBU : ";mg$(i,mg);
7416 print "■                                        "
7420 gosub 400
7422 tu=0 :tk=0 :tc=0 :b(1)=0:b(2)=0 :b(3)=0 :b(4)=0: b(5)=0
7424 for k=1 to nh(kn)
7426 hq(k,1)=0 : hm(k)=0
7428 nextk
7430 for j=1 to 5
7432 for k=1 to 3 : pc(j,k)=0 :next k
7434 next j
7440 dopen#1,(f1$),d1
7442 dopen#2,(f2$),d1
7445 r=fr-1+(mg-1)*nk(i)+kn
7450 for j=fd to ld
7452 record#1,(r),25 :input#1,tp% : tu=tu+tp%
7454 record#1,(r),33 : input#1,in% : tk=tk+in%
7456 p=58 : q=1
7458 for k=1 to nh(kn)
7460 record#1,(r),(p) : input#1,dq% : hq(k,1)=hq(k,1)+dq%
7462 record#2,(r),(q) : input#2,dc% : hm(k)=hm(k)+dc%
7464 p=p+5 : q=q+8
7466 next k
7468 r=r+n(i)
7470 next j
7472 dclose#1
7474 dclose#2
7476 if chg=1 then gosub 800 :goto 7440
7478 for j=1 to 5
7480 max=0
7482 for k=1 to nh(kn)-1
7484 if k=b(1) or k=b(2) or k=b(3) or k=b(4) goto 7488
7486 if max<hm(k) then max=hm(k) : b(j)=k
7488 next k,j
7490 for k=1 to nh(kn) : tc=tc+hm(k) : next k
7495 for j=1 to 5
7500 pc(j,1)=hq(b(j),1)/tk*100: pc(j,1)=int((pc(j,1)+0.005)*100)/100
7502 pc(j,2)=hm(b(j))/tc *100 : pc(j,2)=int((pc(j,2)+0.005)*100)/100
7504 for k=1 to j  : pc(j,3)=pc(j,3)+pc(k,2) : next k
7510 next j
7515 gosub 7800
7520 gosub 7700
7522 print"   URETIM          : ";tu ,"        KONTROL EDILEN : ";tk
7525 print"Hata";spc(8);"Hata tanimi";spc(10);"Ilgili";" Miktar";
7527 print" Maliyet";"  Hatali";" Parasal";" Biriken"
```

```
7530 print"Kodu";spc(29);"Islem ";spc(15);" Yuzdesi";" Yuzde  ";
7532 print " Yuzde  "
7535 gosub 7760
7550 for j=1 to 5
7555 print kd$(b(j));
7560 print spc(3);left$(dc$(j)+sp$,25);
7565 print right$(sp$+il$(val(op$(j))),8);
7570 printright$(sp$+str$(hq(b(j),1)),7);right$(sp$+str$(hm(b(j))),8);
7580 print right$(sp$+str$(pc(j,1)),8);right$(sp$+str$(pc(j,2)),8);
7585 print right$(sp$+str$(pc(j,3)),8)
7590 next j
7595 print
7600 if yy=1 then print#4:close 4: yy=0 :print"■■■■"
7605 gosub 1200
7610 if e$="a" goto 7699
7615 if e$="d" goto 7630
7620 open 7,4,7 : print#7 : close 7
7625 open 4,4 : cmd 4 : yy=1 : goto 7520
7630 gosub 1250
7632 print"■■■■■■■■■■"
7635 on dg goto 7020,7070,7410
7699 goto 4600
7700 rem *****          ekranda tablo olusturulmasi          **********
7710 print "■   URUN GRUBU       :  ";ug$(i)
7715 print:print  "   KONTROL NOKTASI :  ";kn$(i,kn)
7723 print "   MAKINA GRUBU    :  ";mg$(i,mg)
7726 print:print  "   DONEM           :  ";g1$;"-";g2$
7730 return
7750 print"-----------  -------  -------  -------  -------  -------";
7752 print "   -------    -------"
7755 return
7760 print "----  ------------------------  ------ ------ ------- ";
7762 print "------- ------- -------"
7765 return
7800 rem **********    hata kodlarinin aranmasi    ****************
7805 fl$=left$(ug$(i),6)+"/hata"
7810 dopen#1,(fl$),d0
7815 for j=1 to 5
7820 ii=1 : jj=hs : ko$=kd$(b(j))
7825 kk=int((ii+jj)/2)
7830 record#1,(kk),1 :input#1,co$
7835 if ko$=co$ or ii>jj goto 7860
7840 if ko$<co$ goto 7855
7845 ii=kk+1 : goto 7825
7855 jj=kk-1 : goto 7825
7860 record#1,(kk),5 :input#1,dc$(j)
7865 record#1,(kk),31  : input#1,op$(j)
7870 next j
```

```
7875 dc lose#1
7890 return
8000 rem ********************    hatalarin okunmasi   ****************
8002 jj=0
8005 dopen#1,(fl$),d0
8010 jj=jj+1
8015 input#1,kd$(jj) : input#1,lg$(jj)
8020 if kd$(jj)<>"000" goto 8010
8025 dc lose#1
8030 nh(kn)=jj
8040 return
```

APPENDIX D

LISTING OF THE COMPUTER PROGRAM FOR REVISION OF THE INSPECTION PLAN MODULE

```
ready.

 1 clr
 5 ng=8 : sp$="                                "
10 dim p(4,5),pd(4,4),pl%(4,4),y(4,20),op$(4),aoq(4),aoq$(4),aq(4)
12 dim ur%(5),u%(5),um%(5),d(4,6),dn%(4,6),sn%(4,5),nn(4,5)
15 dim hq(8,4,4),ke(8,4),hm(4,6),m(4,4,20),bi(1,4,4),rr(1)
16 dim sp(4,4),ss(4,4),vp(4,4),t%(4,5),x(4),au(4),bu(4),wn(4,4)
17 dim nh(4),om(4,4),hk$(4,20),dq%(4,4),ra$(4),wl%(4,4),wt%(4,4)
18 dim pb(4,6),cn%(4,6),pr(4,6),pi(4),pg(4),pen%(6),dg%(4),dl%(4)
19 dim c$(6),cn$(4,6),ma(4,6),ma$(4,6),ct(4),ct$(4),cr(4),ra(4)
20 op$(1)="STEM    ": op$(2)="MONT    ": op$(3)="SEALEX "
25 pl$(1)="NUMUNE": pl$(2)="100% AYIKLAMA" : pl$(3)="CSP-1"
26 pl$(4)="YOK"    : op$(4)="IKMAL   "
100 goto 3000
200 rem *****     hatali uretme yuzdeleri listesi    ********
205 print"[CLR]"
210 print tab(10)fd$;"-";ld$;" DONEMINDE ORTALAMA HATALI URETME ";
212 print "YUZDELERI "   : print : print tab(27)
215 for i=1 to nm(1) : s=i*8: print mg$(1,i) tab(s+27);: next
220 print
225 for j=1 to 4
230 print tab(15) op$(j) tab(25);
235 for i=1 to nm(1) : s=i*8: print pd(i,j) tab(s+25);: next i
240 print
245 next j
250 return
300 rem *****     tanim dosyasinin okunmasi  ***************
305 dopen#1,"tanim1",d1
310 input#1,wi% :input#1,nu
312 dim ug$(nu),nd(nu),wn%(nu),nm(nu),mg$(nu,4),nk(nu,4)
314 dim kl%(nu,4,4),kn$(nu,4,4),n(nu)
315 for k=1 to nu
320 input#1,ug$(k) : input#1,nd(k) : input#1,wn%(k)
325 next k
330 for k=1 to nu
335 input#1,nm(k)
336 for j=1 to nm(k)
337 input#1,mg$(k,j) : input#1,nk(k,j)
340 for l=1 to nk(k,j)
345 input#1,kn$(k,j,l) : input#1,kl%(k,j,l)
350 next l,j,k
355 dclose#1
360 for k=1 to nu
365 for j=1 to nm(k)
370 n(k)=n(k)+nk(k,j)
375 next j,k
390 return
```

```
ready.

400 rem ***  hata dosyalarinin okunmasi          **********
405 for k=1 to 4
410 fl$="enk/"+str$(k)+"/hata" : j=0
412 dopen#1,(fl$),d0
413 j=j+1
414 input#1,hk$(k,j): input#1,y(k,j)
415 if hk$(k,j)="000" goto 417
416 goto 413
417 nh(k)=j
418 dclose#1
419 next k
420 return
430 rem ***  hatali  uretme  yuzdelerinin  hesaplanmasi  ***
435 print"S000000"
440 print"                    ********************************************"
442 print"                    *                                          *"
443 print"                    *          SON 20 IS GUNU ICIN             *"
444 print"                    *        HATALI URETME YUZDELERI           *"
446 print"                    *          HESAPLANMAKTADIR                *"
448 print"                    *                                          *"
449 print"                    ********************************************"
465 ld=nd(1)  : fd=ld-ng+1 : f=1+(fd-1)*n(1) : l=ld*n(1)
470 dopen#1,"enkand/iml",d1
472 dopen#2,"enkand/tl",d1
473 record#1,(f),6 : input#1,fd$
474 record#1,(l),6 : input#1,ld$
475 t1$=left$(fd$,2):t2$=mid$(fd$,3,2):t3$=right$(fd$,2)
476 fd$=t3$+"/"+t2$+"/"+t1$
477 t1$=left$(ld$,2):t2$=mid$(ld$,3,2):t3$=right$(ld$,2)
478 ld$=t3$+"/"+t2$+"/"+t1$
479 j=0
480 for g=fd to ld
482 j=j+1
484 r=(g-1)*n(1)
486 for k=1 to nm(1)
490 for l=1 to nk(1,k)
492 r=r+1
496 record#1,(r),33  : input#1,in%  : ke(j,k)=ke(j,k)+in%
498 p=58  :  ll=kl%(1,k,l) : t=1
500 for kk=1 to nh(ll)
502 record#1,(r),(p): input#1,h%
503 dq%(k,ll)=dq%(k,ll)+h% : hq(j,k,y(ll,kk))=hq(j,k,y(ll,kk))+h%
504 record#2,(r),(t): input#2,c%: hm(k,ll)=hm(k,ll)+c%
506 if ll=1 or h%=0 goto 524
508 for z=1 to ll-1
510 if y(ll,kk)>z goto 520
512 for zz=1 to nh(z)-1
514 if hk$(ll,kk)=hk$(z,zz) goto 516
```

```
ready.

 515 next zz
 516 dc=h%*(m(k,z,zz)+bi(1,z,k))*(1+rr(1))
 517 hm(k,z)=hm(k,z)+dc
 518 dq%(k,z)=dq%(k,z)+h%
 520 next z
 524 p=p+5 : t=t+8
 525 next kk
 526 next l
 527 next k
 528 next g
 529 dclose#1
 530 dclose#2
 537 j=0
 540 dopen#1,"enkand/son",d1
 542 dopen#2,"enk/glow",d1
 544 dopen#3,"enk/isik",d1
 545 for g=fd to ld
 547 r=(g-1)*n(1) : j=j+1
 550 for k=1 to nm(1)
 552 r=r+1
 556 record#1,(r),33 : input#1,in% : ke(j,k)=ke(j,k)+in%
 558 q=1
 559 record#2,(r),(q): input#2,kd$
 560 record#2,(r),(q+4): input#2,y$
 562 if y$="" goto 570
 564 record#2,(r),(q+6) : input#2,h%
 566 yy=val(y$) : hq(j,k,yy)=hq(j,k,yy)+h% :pi(k)=pi(k)+h%
 567 record#2,(r),(q+11): input#2,c%: hm(k,5)=hm(k,5)+c%
 568 gosub 635
 569 q=q+19 : if q<160 goto 560
 570 p=1
 571 record#3,(r),(p): input#3,kd$
 572 record#3,(r),(p+4): input#3,y$
 574 if y$="" goto 582
 576 record#3,(r),(p+6) : input#3,h%
 578 yy=val(y$) : hq(j,k,yy)=hq(j,k,yy)+h%  :pg(k)=pg(k)+h%
 579 record#3,(r),(p+11): input#3,c%: hm(k,5)=hm(k,5)+c%
 580 gosub 635
 582 p=p+19 :  if p<160 goto 572
 584 next k
 586 next g
 590 dclose#3
 595 dclose#2
 600 dclose#1
 601 for k=1 to nm(1)
 602 for l=1 to 4 : sp(k,l)=0 :ss(k,l)=0 : next l
```

```
604 next k
605 for k=1 to nm(1)
606 pc=pc+(pg(k)/(pg(k)+pi(k)))
607 for l=1 to 4
608 for j=1 to ng
612 px=hq(j,k,l)/ke(j,k)
613 sp(k,l)=sp(k,l)+px
614 ss(k,l)=ss(k,l)+(px%2)
615 next j
617 pd(k,l)=sp(k,l)/ng
618 vp(k,l)=ss(k,l)-(ng*(pd(k,l)%2))
619 vp(k,l)=sqr(vp(k,l)/(ng-1))
620 pd(k,l)=int((pd(k,l)+0.0005)*1000)/1000
622 vp(k,l)=int((vp(k,l)+0.00005)*10000)/10000
629 hm(k,l)=int((hm(k,l)/dq%(k,l)+0.0005)*1000)/1000
631 next l
632 next k
633 pc=pc/nm(1)
634 return
635 rem ***   maliyetleri toplar                    ***
636 for z=1 to 4
638 if yy>z goto 648
640 for zz=1 to nh(z)-1
642 if kd$=hk$(z,zz) goto 646
644 next zz
645 return
646 hm(k,z)=hm(k,z)+(h%*(m(k,z,zz)+bi(1,z,k))*(1+rr(1)))
648 next z
649 return
650 rem ***  hatali yuzdelerini dosyalar            ***
655 fl$="@defper" : if d1$="" then fl$="defper"
660 dopen#1,(fl$),d0,w
665 print#1,fd$ : print#1,ld$
670 for i=1 to 4
675 for j=1 to 4
680 print#1,pd(i,j) : print#1,vp(i,j)
685 next j
690 next i
694 dclose#1
695 return
```

```
eady.

700 rem ***  hatali yuzdelerinin  ekrandan alinmasi ***
705 print"■■■■■■■"
710 for j=1 to 4
712 print tab(24);
715 for i=1 to nm(1)
720 s=i*8
722 input a$ : a$=left$(a$,7)
725 pd(i,j)=val(a$)    : print "■";tab(24+s);
730 next i
735 print
740 next j
742 gosub 200 :stop
745 return
750 rem ***     uretim sinirlarini okur-yazar    ***************
752 dopen#1,"uretim",d0
754 for k=1 to nm(1)
756 input#1,au(k) : input#1,bu(k)
760 next k
762 dclose#1
764 if au(1)=0 then yok=1
766 return
770 fl$="@uretim" : if yok then fl$="uretim" : yok=0
772 dopen#1,(fl$),d0,w
774 for k=1 to nm(1)
776 print#1,au(k) : print#1,bu(k)
778 next k
780 dclose#1
790 return
800 rem ***     ortalama gunluk  uretim    ********************
805 gosub 750
810 print"■■■■■"
815 print tab(25)"GUNLUK URETIM MIKTARLARI■"
820 for j=1 to mn
825 jj=mak%(j)
830 print tab(25)mg$(1,jj)tab(35)au(jj)tab(43)","tab(45) bu(jj)
835 next j
840 print tab(20)"■Bu degerlerin yerine kullanilmak uzere"
842 print tab(20)"ortalama gunluk uretim miktarlarini"
844 print tab(20)"yeniden belirlemek ister misiniz ( e/h ) ";
850 input c$ : if c$<>"e" goto 890
855 print "■■■■■■■"
860 for j=1 to mn
865 jj=mak%(j) : print tab(34); : input au(jj),bu(jj)
870 next j
880 gosub 770
890 return
```

```
ready.

 900 rem ***       ortalama maliyetler       ******************
 901 fl$="@ormaliyet" : if dl$="" then fl$="ormaliyet"
 905 dopen#1,(fl$),d0,w
 910 for k=1 to nm(1)
 915 for l=1 to 4
 917 print#1,hm(k,l)
 925 next l
 930 next k
 932 pc=0.65:  print#1,pc
 935 dclose#1
 940 return
 950 rem ***  ortalama maliyetleri okur            ***********
 955 dopen#1,"ormaliyet",d0
 960 for k=1 to nm(1)
 965 for l=1 to 4
 968 input#1,hm(k,l)
 980 next l
 985 next k
 987 input#1,pc
 990 dclose#1
 995 return
1000 rem ***  rastsal degiskenlerin uretilmesi  ***********
1010 for j=1 to mn
1015 k=mak%(j) : ru=rnd(137)
1020 ur%(k)=au(k)+(bu(k)-au(k))*ru
1025 r1=rnd(521) : r2=rnd(345) : r3=rnd(276) : r4=rnd(635)
1030 x(1)=sqr(-2*log(r2))*sin(2*3.1416*r1)
1035 x(2)=sqr(-2*log(r2))*cos(2*3.1416*r1)
1040 x(3)=sqr(-2*log(r4))*sin(2*3.1416*r3)
1045 x(4)=sqr(-2*log(r4))*cos(2*3.1416*r3)
1050 for l=1 to 4
1055 p(k,l)=pd(k,l)+x(l)*vp(k,l)
1060 next l
1065 next j
1090 return
```

```
ready.

 1200 rem ***     kontrol plani benzetimi          ***************
 1220 for j=1 to mn
 1225 jj=mak%(j) : d(jj,1)=p(jj,1): pr(jj,1)=pr(jj,1)+d(jj,1)
 1230 u%(jj)=ur%(jj) : um%(jj)=ur%(jj)
 1235 for k=1 to 4
 1237 pl=pl%(jj,k)
 1240 on pl  goto 1245,1250,1255,1260
 1245 sn%(jj,k)=nn(jj,k)   : goto 1265
 1250 sn%(jj,k)=um%(jj)    : goto 1265
 1255 afi=nn(jj,k)/(nn(jj,k)+((1-d(jj,k))^t%(jj,k))*(1-nn(jj,k)))
 1258 sn%(jj,k)=um%(jj)*afi  :goto 1265
 1260 sn%(jj,k)=0
 1265 dn%(jj,k)=sn%(jj,k)*d(jj,k)  : cn%(jj,k)=cn%(jj,k)+dn%(jj,k)
 1270 u%(jj)=um%(jj)-sn%(jj,k)
 1275 um%(jj)=um%(jj)-dn%(jj,k)
 1280 d(jj,k+1)=u%(jj)*((1-d(jj,k))*p(jj,k+1)+d(jj,k))/um%(jj)
 1282 pr(jj,k+1)=pr(jj,k+1)+d(jj,k+1)
 1285 next k
 1290 sn%(jj,5)=nn(jj,5)*um%(jj)
 1295 dn%(jj,5)=sn%(jj,5)*d(jj,5)*(1-pc):cn%(jj,6)=cn%(jj,6)+dn%(jj,5)
 1299 cp(jj)=0
 1300 for kk=1 to 6
 1310 cp(jj)=cp(jj)+pen%(kk)*dn%(jj,5)*pb(jj,kk)
 1315 next kk
 1320 ri(jj)=cp(jj)/t%(jj,5)*120    : cr(jj)=cr(jj)+ri(jj)
 1325 dg%(jj)=um%(jj)*d(jj,5)*pc    : cn%(jj,5)=cn%(jj,5)+dg%(jj)
 1340 dl%(jj)=ri(jj)*d(jj,5)*(1-pc): cn%(jj,6)=cn%(jj,6)+dl%(jj)
 1345 u%(jj)=um%(jj)-ri(jj)
 1347 um%(jj)=um%(jj)*(1-d(jj,5))+u%(jj)*d(jj,5)*(1-pc)
 1350 aoq(jj)=u%(jj)*d(jj,5)*(1-pc)/um%(jj)
 1355 aq(jj)=aq(jj)+aoq(jj) : ra(jj)=ra(jj)+um%(jj)/ur%(jj)
 1480 next j
 1490 return
 1500 rem ************************************************************
 1510 for j=1 to mn
 1515 jj=mak%(j) : hm(jj,5)=hm(jj,4): hm(jj,6)=hm(jj,4)
 1520 for k=1 to 6
 1525 dn%(jj,k)=cn%(jj,k)/ng : cn%(jj,k)=dn%(jj,k)*hm(jj,k)
 1527 d(jj,k)=pr(jj,k)/ng    : ct(jj)=ct(jj)+cn%(jj,k)
 1530 next k
 1535 ri(jj)=cr(jj)/ng
 1550 aoq(jj)=aq(jj)/ng
 1555 ra(jj)=ra(jj)/ng
 1560 for k=1 to 6
 1565 ma(jj,k)=cn%(jj,k)/ct(jj)
 1570 next k
 1585 next j
 1590 return
```

```
ready.

 1600 rem ***********      ilkleme     ***************************
 1610 for k=1 to 4
 1615 for j=1 to 6
 1620 cn%(k,j)=0 : pr(k,j)=0
 1625 next j
 1635 cr(k)=0 : aq(k)=0 : ra(k)=0 : ct(k)=0
 1640 next k
 1645 return
 1800 rem ******   deneme dosyasini okur  ********************
 1805 ff$="deneme"+str$(c)
 1810 dopen#1,(ff$),d0
 1815 input#1,mm
 1820 for l=1 to mm :input#1,mam%(l): next l
 1825 for k=1 to mm
 1827 jj=mam%(k)
 1830 for l=1 to 4
 1832 input#1,pl%(jj,l):input#1,nn(jj,l) : input#1,t%(jj,l)
 1834 next l
 1835 input#1,nn(jj,5) : input#1,t%(jj,5)
 1836 for l=1 to 6
 1838 input#1,c$(l)
 1840 input#1,d$(jj,l): input#1,cn$(jj,l): input#1,ma$(jj,l)
 1845 next l
 1850 input#1,ct$(jj):input#1,aoq$(jj):input#1,ra$(jj)
 1855 next k
 1860 dclose#1
 1870 return
 1900 rem ****   isik hatalari ciddiyet dagilimi  **************
 1910 dopen#1,"isikceza",d0
 1915 for i=1 to 6
 1920 input#1,pen%(i)
 1925 next i
 1930 for j=1 to nm(1)
 1935 for i=1 to  6
 1940 input#1,pb(j,i)
 1945 next i,j
 1949 dclose#1 : return
 2000 rem ****       maliyetleri okur              ***************
 2010 for k=1 to 4
 2015 ff$=left$(ug$(1),3)+"/"+str$(k)+"/mtl"
 2020 dopen#1,(ff$),d0
 2025 for j=1 to nh(k)
 2030 for l=1 to 3
 2035 input#1,mm : m(1,k,j)=m(1,k,j)+mm
 2041 next l
 2042 m(1,k,j)=m(1,k,j)/3  : m(2,k,j)=m(1,k,j)
 2046 for l=4 to 7
 2048 input#1,mm : m(3,k,j)=m(3,k,j)+mm
 2050 next l
 2052 m(3,k,j)=m(3,k,j)/4 : m(4,k,j)=m(3,k,j)
```

```
ready.
 2054 next j
 2056 dclose#1
 2058 next k
 2060 dopen#1,"enk/isci",d0
 2066 for k=1 to 4
 2068 for j=1 to nm(1)
 2070 input#1,bi(1,k,j)
 2072 next j
 2074 next k
 2076 dclose#1
 2080 dopen#1,"ime",d0
 2085 input#1,rr(1)
 2090 dclose#1
 2095 return
 2100 rem ***     kontrol planlarini okur     ********************
 2105 dopen#1,"planlar",d0
 2110 for jj=1 to mn
 2115 r=(mak%(jj)-1)*5 :k=mak%(jj)
 2120 for j=1 to 4
 2125 r=r+1
 2130 record#1,(r),28 : input#1,pl%(k,j)
 2132 if pl%(k,j)=4 goto 2138
 2134 record#1,(r),32 : input#1,nn(k,j)
 2136 record#1,(r),40 : input#1,t%(k,j)
 2138 next j
 2140 record#1,(r+1),28 : input#1,nn(k,5)
 2142 record#1,(r+1),37 : input#1,t%(k,5)
 2146 next jj
 2148 dclose#1
 2149 return
 2150 rem ***  hatali uretme yuzdeleri     **********************
 2155 dopen#1,"defper",d0
 2160 input#1,d1$ : input#1,d2$
 2162 if d1$="" then dclose#1 : goto 2220
 2165 for i=1 to nm(i)
 2170 for j=1 to 4 :input#1,pd(i,j):input#1,vp(i,j): next j
 2180 next i
 2185 dclose#1
 2190 m1$=mid$(td$,4,2)
 2195 fd$=d1$ : ld$=d2$ : gosub 200
 2200 print"■"tab(10)"Bu degerler : ■"
 2202 printtab(12)"■o■ldugu gibi mi kullanilsin,"
 2203 m2$=mid$(ld$,3,2) : if m1$=m2$ goto 2205
 2204 printtab(12)"■s■on 20 is gunu icin yeniden mi hesaplansin"
 2205 printtab(12)"■k■endiniz mi belirleyeceksiniz ■"
 2206 printtab(12);: input c$
 2210 if c$="o" goto 2230
 2212 if c$="s" then gosub 400:gosub2000:gosub 430: goto 2217
 2214 if c$="k" then gosub 700 : goto 2230
 2216 print"! Hatali";"■■" : goto 2206
 2217 gosub 200 :gosub 650 :gosub 900 :goto 2200
 2220 gosub 400 :gosub 2000 :gosub 430 :gosub 200
 2225 gosub 650 :gosub 950 :goto 2200
 2230 return
```

```
ready.

 2250 rem ***          ortalama maliyetler          ******************
 2252 gosub 950
 2254 print"■■■■■"
 2256 print tab(25)"ORTALAMA  HATA  MALIYETLERI"
 2258 print :print tab(26)
 2260 for i=1 to nm(1)
 2262 s=i*8 : print mg$(1,i) tab(s+27);
 2264 next i
 2266 print"■"
 2268 for j=1 to 4
 2270 print tab(15) op$(j) tab(24);
 2272 for i=1 to nm(i)
 2274 s=i*8 : print hm(i,j) tab(s+25);
 2276 next i
 2278 print
 2280 next j
 2282 print tab(25)"■■Devam edelim mi (e) "; : input c$
 2290 return
 2300 rem ***           makina grubu secimi          ***************
 2301 print"■■■■■": j=1 :mn=0
 2302 print tab(15)"*  KONTROL PLANLARI UZERINDEKI CALISMAYI "
 2303 print tab(15)"   HANGI MAKINA GRUPLARI ICIN YAPACAKSINIZ ?"
 2310 print"■          (sonuncudan sonra veya tum gruplar icin ise";
 2311 print"  ( - )  yaziniz)■"
 2315 print tab(25); : input xx$
 2320 if xx$="-" goto 2355
 2330 for mg=1 to nm(1)
 2335 if xx$=mg$(1,mg) goto 2350
 2340 next
 2345 print"! Hatali";"■■" : goto 2315
 2350 mak%(j)=mg : j=j+1 : goto 2315
 2355 mn=j-1 : if mn>0 goto 2380
 2360 mn=nm(1)
 2365 for k=1 to mn : mak%(k)=k : next k
 2380 return
```

```
eady.

2400 rem ***      deneme planini ekrandan alir  *******
2420 for k=1 to mn
2424 jj=mak%(k) : ii=i-1
2426 print"■■■■"
2430 printtab(25)mg$(1,jj)tab(31)"KONTROL PLANI : "tab(50)ii
2432 print
2435 for l=1 to 4
2440 print tab(21);l;". ";op$(l);tab(38)": ";
2445 p=pl%(k,l) : print pl$(p);
2450 on p  goto 2452,2455,2454,2455
2452 print tab(44)"(";nn(k,l);"  adet)" : goto 2460
2454 print tab(44)"( f=";nn(k,l);"  ,i=";t%(k,l);" )": goto 2460
2455 print
2460 next l
2462 print tab(22)"5 . SON KONTROL"tab(38)": ";nn(k,5);
2464 print " lik numune":print tab(40)"ceza puani limiti ";t%(k,5)
2465 print : print tab(18);
2470 input "Degistirmek istediginiz nokta ( 0-5 ) ";l
2472 if l=0 goto 2545
2474 if l=5 goto 2510
2475 print"■"tab(18)"■1: Numune / 2: 100% ayiklama / 3: CSP-1 / 4: yok"
2480 print "■"tab(21)l;". ";op$(l)tab(38)": ";
2485 input pl%(k,l)
2490 on pl%(k,l) goto 2492,2506,2496,2506
2492 print"■"tab(25)"Gunluk toplam numune adedi : ";
2494 input nn(k,l) : t%(k,l)=0 : goto 2506
2496 print"■"tab(25)"Numune orani"tab(53)"(f) : ";
2498 input nn(k,l)
2500 print tab(25)"Ayiklamaya son vermek icin "
2502 print tab(25)"gereken saglam ampul sayisi (i) : ";
2504 input  t%(k,l) : goto 2506
2506 ii=i : goto 2426
2510 print tab(22)"5 . SON KONTROL "tab(38)": "
2520 print"■"tab(25)"Numune yuzdesi : ";
2525 input nn(k,5)
2530 print tab(25)"Isik kontrolunda kabul edilebilir"
2535 print tab(25)"en yuksek ceza puani              : ";
2540 input t%(k,5)
2542 ii=i : goto 2426
2545 for l=1 to 2000 : next
2547 next k
2549 return
```

```
eady.

2600 rem ***  deneme plani raporunun hazirlanmasi      **********
2601 if c<i goto 2700
2605 for k=1 to mn
2607 jj=mak%(k)
2610 for l=1 to 4
2615 p=pl%(jj,l)
2620 on p goto 2625,2630,2635,2640
2625 c$(l)=pl$(p)+"  ("+str$(nn(jj,l))+" adet )": goto 2642
2630 c$(l)=pl$(p)          : goto 2642
2635 c$(l)=pl$(p)+"(f="+str$(nn(jj,l))+",i="+str$(t%(jj,l))+")"
2637 goto 2642
2640 c$(l)=pl$(p)
2642 next l
2643 c$(5)=str$(nn(jj,5))      :c$(6)=str$(t%(jj,5))
2645 for l=1 to 6
2647 if l=6 then d(jj,l)=d(jj,5)*(1-pc):goto 2652
2650 d(jj,l)=int((d(jj,l)*10000)+.5)/100
2652 d$(jj,l)=str$(d(jj,l))
2654 if len(d$(jj,l))>=4 goto 2667
2656 if left$(d$(jj,l),1)="." then d$(jj,l)="0"+d$(jj,l):goto2665
2658 if right$(d$(jj,l),2)="." then d$(jj,l)=d$(jj,l)+"0":goto2665
2660 d$(jj,l)=d$(jj,l)+".0"
2667 cn$(jj,l)=str$(cn%(jj,l))
2670 ma(jj,l)=int((ma(jj,l)*10000)+.5)/100
2672 ma$(jj,l)=str$(ma(jj,l))
2674 if len(ma$(jj,l))>=4 goto 2685
2676 if left$(ma$(jj,l),1)="." then ma$(jj,l)="0"+ma$(jj,l):goto 2685
2678 if right$(ma$(jj,l),2)="."then ma$(jj,l)=ma$(jj,l)+"0":goto2685
2680 ma$(jj,l)=ma$(jj,l)+".0"
2685 next l
2690 ct$(jj)=str$(ct(jj))
2695 aoq$(jj)=str$(aoq(jj))     :ra$(jj)=left$(str$(ra(jj)),7)
2699 c=i
2700 for l=1 to 4 : c$(l)=left$(c$(l)+sp$,26) :next l
2701 for l=1 to 6 : d$(jj,l)=left$(d$(jj,l)+sp$,13)
2702 cn$(jj,l)=right$(sp$+cn$(jj,l),9) :next l
2703 ct$(jj)=right$(sp$+ct$(jj),9)
2704 gosub 2750
2705 print "■■       y : yaz  / t : tamam       ■  ";:input c$
2710 if c$="t" goto 2740
2715 if c$<>"y" then print"■■";: goto 2705
2718 open7,4,7 :print#7 :close 7
2720 open 4,4 : cmd 4
2725 gosub 2750 : print#4 : close 4
2730 print "■■";: goto 2705
2735 next k
2740 return
```

```
ready.

 2750 rem ************************************************************
 2755 print"■"
 2760 print spc(7);mg$(1,jj);spc(20);"KONTROL NOKTASINDA";
 2762 print spc(3);"HATALI";spc(6);"MALIYET"
 2764 print spc(1);"KONTROL PLANI :";c;spc(11);
 2766 print "HATALI YUZDESI (%)";spc(3);"MALIYETI";spc(4);
 2768 print "AGIRLIGI (%)"
 2770 print spc(51);"(tl/gun)"
 2775 for l=1 to 4
 2776 print: print" ";op$(l);":";c$(l);d$(jj,l);
 2777 print cn$(jj,l);spc(7);ma$(jj,l)
 2778 next l
 2780 print:print" GLOW    : Son kontrol numunesi      ";d$(jj,5);
 2782 print cn$(jj,5);spc(7);ma$(jj,5) : print spc(15);c$(5)
 2784 print" ISIK    : Ceza puani limiti ";c$(6);spc(3);d$(jj,6);
 2786 print cn$(jj,6);spc(7);ma$(jj,6)
 2788 print spc(51);"----------";spc(3);"----------"
 2790 print" TOPLAM";spc(41);ct$(jj);spc(7);"100.00":print
 2792 print" ORTALAMA CIKIS KALITESI : ";aoq$(jj);
 2793 print spc(8);"VERIMLILIK : ";ra$(jj)
 2794 return
 2800 rem ****  deneme planinin dosyalanmasi    ****************
 2805 ff$="deneme"+str$(i)
 2810 dopen#1,(ff$),d0,w
 2815 print#1,mn
 2820 for l=1 to mn : print#1,mak%(l) : next l
 2825 for k=1 to mn
 2827 jj=mak%(k)
 2830 for l=1 to 4
 2832 print#1,pl%(jj,l):print#1,nn(jj,l):print#1,t%(jj,l)
 2834 next l
 2835 print#1,nn(jj,5):print#1,t%(jj,5)
 2836 for l=1 to 6
 2838 print#1,c$(l)
 2840 print#1,d$(jj,l):print#1,cn$(jj,l):print#1,ma$(jj,l)
 2845 next l
 2850 print#1,ct$(jj): print#1,aoq$(jj): print#1,ra$(jj)
 2855 next k
 2860 dclose#1
 2870 return
```

```
ready.

 2900 rem ***  kontrol plani dosyasini yeniler  ***************
 2905 dopen#1,"planlar",d0
 2910 for k=1 to mn
 2915 r=(mak%(k)-1)*5
 2920 for j=1 to 4
 2925 r=r+1
 2930 record#1,(r),28 : input#1,wl%(k,j)
 2932 if wl%(k,j)=4 goto 2138
 2934 record#1,(r),32 : input#1,wn(k,j)
 2936 record#1,(r),40 : input#1,wt%(k,j)
 2938 next j
 2940 record#1,(r+1),28 : input#1,wn(k,5)
 2942 record#1,(r+1),27 : input#1,wt%(k,5)
 2948 dclose#1
 2950 dopen#1,"planlar",d0
 2952 for k=1 to mn
 2954 r=(mak%(k)-1)*5
 2956 for j=1 to 4
 2958 r=r+1
 2960 record#1,(r),1 : print#1,wl%(k,j)
 2962 record#1,(r),5 : print#1,wn(k,j)
 2964 record#1,(r),13 :print#1,wt%(k,j)
 2966 record#1,(r),19 :print#1,td$
 2980 record#1,(r),28 : print#1,pl%(k,j)
 2982 record#1,(r),32 : print#1,nn(k,j)
 2984 record#1,(r),40 : print#1,t%(k,j)
 2986 next j
 2988 record#1,(r+1),1 : print#1,wn(k,5)
 2990 record#1,(r+1),11: print#1,wt%(k,5)
 2992 record#1,(r+1),25 : print#1,nn(k,5)
 2994 record#1,(r+1),34 : print#1,t%(k,5)
 2996 dclose#1
 2999 return
```

```
eady.

3000 print"■";
3010 print"*****************************************************************"
3015 print"*                                                               *"
3020 print"*  ***********************************************************  *"
3025 print"*  *                                                         *  *"
3030 print"*  *                  * K K K D S *                          *  *"
3035 print"*  *    K O N T R O L   P L A N I   Y E N I L E M E          *  *"
3041 print"*  *                                                         *  *"
3042 print"*  ***********************************************************  *"
3046 print"*                                                               *"
3048 print"*   *        K o n t r o l   n o k t a l a r i n i n          *"
3050 print"*   y e r l e r i n d e   v e   n u m u n e   p l a n -      *"
3052 print"*   l a r i n d a   y a p a c a g i n i z   d e g i -        *"
3054 print"*   s i k l i k l e r i n   k a l i t e   m a l i y e -      *"
3056 print"*   t i n e   e t k i l e r i n i   h e s a p l a r .        *"
3058 print"*                                                               *"
3060 print"*   *        E n   s o n   v e r i   d i s k e t i n i        *"
3062 print"*   d r i v e : 1 ' e   y e r l e s t i r i n i z            *"
3064 print"*                                                               *"
3066 print"*   *        B u g u n k u   t a r i h i   v e r i -          *"
3068 print"*   n i z   ( GG/AA/YY )                                        *"
3070 print"*                                                               *"
3072 print"*****************************************************************"
3074 print" Bogazici Universitesi,Endustri Muhendisligi Bolumu,1984"
3076 print"■■■■";tab(33);
3080 input td$ : td$=left$(td$,8)
3085 dopen#1,"@today",d0,w : print#1,td$ : dclose#1
3090 gosub 300
3095 gosub 2150
3100 gosub 2250
3105 gosub 2300
3110 gosub 800
3115 gosub 1900
3120 gosub 2100
3125 i=0
3130 rx=rnd(-734)
3132 for g=1 to ng
3135 gosub 1000 : gosub 1200
3140 next g
3145 gosub 1500
3150 c=i: gosub 2600 :  gosub 2800
3155 print"■■■■■■■■■■"tab(15)"CALISMAYA  DEVAM  EDECEK MISINIZ  ";
3156 print"( e / h )";: input c$ : if c$<>"e" goto 3300
3165 if i=0 goto 3200
3169 print"■■■■■■■■■■";
3170 print tab(15)"ELDEKI DENEME PLANLARININ MALIYET RAPORLARINDAN"
3175 print tab(15)          "GORMEK ISTER MISINIZ  ( e / h ) ";
```

```
3180 input c$ : if c$<>"e" goto 3200
3185 print "■"tab(15)        "HANGISINI   ( 0 -";i;" ) ";
3190 input c : gosub 1800 : gosub 2600 : goto 3155
3200 i=i+1 : gosub 2400
3210 gosub 1600 : goto 3130
3300 if i=0  goto 3330
3309 print"■■■■■■■■■■";
3310 print tab(15)"HANGI  KONTROL  PLANINI  UYGULAMAYA  KARAR"
3315 print tab(15)            "VERDINIZ   ( 0 -";i;" ) ";
3320 input c     : if c=0 goto 3330
3325 gosub 1800 : gosub 2900
3330 scratch"deneme*"
3700 rem ****                    cikis                    ****************
3701 print"■";
3702 print"*****************************************************************"
3705 print"*                                                               *"
3710 print"*  ***********************************************************  *"
3715 print"*  *                                                         *  *"
3720 print"*  *                  * K K K D S *                          *  *"
3725 print"*  *      K A L I T E   K O N T R O L   K A R A R            *  *"
3730 print"*  *           D E S T E K   S I S T E M I                   *  *"
3735 print"*  *                                                         *  *"
3740 print"*  ***********************************************************  *"
3745 print"*                                                               *"
3750 print"*        <1>  V e r i   E k l e n m e s i                       *"
3755 print"*                                                               *"
3760 print"*        <2>  H a t a   A n a l i z i                           *"
3765 print"*                                                               *"
3770 print"*        <3>  K K   P l a n i   Y e n i l e m e                 *"
3775 print"*                                                               *"
3780 print"*        <4>  K K   D e s t e k   D o s y a l a r i             *"
3785 print"*                                                               *"
3790 print"*        <5>  S o n                                             *"
3795 print"*                                                               *"
3800 print"*        Yapilacak  islemi  belirleyiniz                        *"
3805 print"*                                                               *"
3810 print"*****************************************************************"
3815 print" Bogazici Universitesi,Endustri Muhendisligi Bolumu,1984"
3820 print"■■■■";tab(54);
3825 input s$ : s$=left$(s$,2) : s=val(s$)
3830 on s goto 3850,3860,100,3880,3890
3835 print"! Hatali";"■";tab(54); : goto 3825
3850 dload"veriekler",d0
3860 dload"hata analizi",d0
3880 dload"kk dosyalari",d0
3890 dopen#1,"@today",d0,w : print#1,"0" : dclose#1
3895 end
```

APPENDIX E

LISTING OF THE COMPUTER PROGRAM FOR DATA INPUT MODULE

```
ready.

 110 print"■"
 112 print"*************************************************************"
 114 print"*                                                           *"
 116 print"*  ***********************************************************  *"
 118 print"*  *                                                         *  *"
 120 print"*  *                  * KKKDS *                              *  *"
 122 print"*  *       V E R I   E K L E M E   P R O G R A M I           *  *"
 124 print"*  *                                                         *  *"
 126 print"*  ***********************************************************  *"
 128 print"*                                                           *"
 129 print"*                                                           *"
 130 print"*   G u n l u k   i s k a r t a   r a p o r l a r i n i     *"
 132 print"*   v e r i   d o s y a l a r i n a   i s l e r             *"
 134 print"*                                                           *"
 135 print"*   E n   s o n   v e r i   d i s k e t i n i               *"
 136 print"*   d r i v e : 1 ' e   y e r l e s t i r i n i z           *"
 138 print"*                                                           *"
 142 print"*                                                           *"
 143 print"*   B a s l a y a b i l i r   m i y i z ( e/h )             *"
 144 print"*                                                           *"
 145 print"*                                                           *"
 146 print"*                                                           *"
 148 print"*************************************************************"
 150 print"■■■■■";tab(60);
 152 input c$
 154 if c$<>"e    *" then print"■";tab(60);:goto 152
 155 print
 156 print"*   i : Imalat kontrollari / s : Son kontroller            *"
 157 print"■";tab(60);:input d$
 158 if d$="i    *" goto 162
 159 if d$="s    *" goto 162
 160 goto 157
 162 rem ***************  tanim dosyasini okur ***************************
 164 dopen#1,"tanim",d1
 165 input#1,wi%
 166 input#1,nu
 168 if nu=0 then dclose#1: goto 900
 169 dim mg$(nu,10),kn$(nu,10,4),kl%(nu,10,4),ng(nu),wn%(nu),nk(nu,10)
 170 for i=1 to nu
 172 input#1,ug$(i) : input#1,ng(i) : input#1,wn%(i)
 174 next
 178 for i=1 to nu
 180 input#1,nm(i)
 182 for j=1 to nm(i)
 184 input#1,mg$(i,j)
 186 input#1,nk(i,j)
 188 for k=1 to nk(i,j)
```

```
ready.

 190 input#1,kn$(i,j,k) : input#1,kl%(i,j,k)
 192 next k,j
 194 next i
 195 dclose#1
 196 for i=1 to nu
 197 for j=1 to nm(i) :n(i)=n(i)+nk(i,j) :next
 198 nexti
 199 dim kd$(4,20),dq%(20),hm%(20),nh(nu,10) ,dc%(20),tl%(20),dc(20)
 200 gosub 1500 : if left$(d$,1)="s" goto 2000
 201 gosub 1400
 202 for j=1 to nu
 203 print"■■■■■■" :print tab(25)"■"ug$(j);"  imalati"
 204 print "■" tab(20);
 205 input "Kac gunluk veri eklenecek";g(j)    : print
 206 if g(j)=0 goto 540
 208 cr=ng(j)*n(j) : fl$=left$(ug$(j),6)+"/iml"
 209 ff$=left$(ug$(j),6)+"/tl"
 210 dopen#1,(fl$),d1
 212 dopen#2,(ff$),d1
 215 for i=1 to g(j)
 217 print tab(20); : input"Hafta no.                    ";w%
 218 if w%>= wn%(j) then wn%(j)=w% : goto 220
 219 print" ! Hatali";"■■" : goto 217
 220 print tab(20); : input"Tarih ( GG,AA,YY )          ";t1$,t2$,t3$
 225 dt$=t3$+t2$+t1$
 230 ta$=t1$+"/"+t2$+"/"+t3$
 240 if len(dt$)=6 and t1$<="31" and t2$<="12" goto 250
 245 print" ! Hatali";"■■": goto 220
 250 for l=1 to nm(j)
 260 for k=1 to nk(j,l)
 270 print"■":print"    ";
 280 print"TARIH : ";ta$ tab(23) "URUN GRUBU : ";ug$(j) tab(51);
 282 print"MAK.GRUBU/VARDIYA : ";mg$(j,l) : print
 285 print tab(18)"KONTROL NOKTASI : ";kn$(j,l,k) :print
 286 for ln=1 to 79 : print"-"; :next :print
 290 input"      Ampul cinsi ( Watt/Volt )";wv$
 291 if wv$="arizali" then  gosub 1660 :goto 445
 292 wv$=right$(" "+wv$,7)
 293 if mid$(wv$,4,1)<>"/"then print"!Hatali""■■":goto 290
 294 gosub 1680
 295 input"      Ampul tip kodu             ";ty$
 297 if len(ty$)<>1 then print"! Hatali";"■■":goto 295
 300 input"      Ampul renk kodu            ";cl$
 302 if len(cl$)<>1 then print"! Hatali";"■■":goto 300
 305 input"      Uretim miktari             ";pq%
 310 input"      Numune adedi               ";kq%
 312 if kq%>pq% or kq%>9999  then print"! Hatali";"■■":goto 310
 315 input"      Toplam hatali              ";df%
 317 if df%>kq% or df%>999   then print"! Hatali";"■■":goto 315
```

```
320 input"      Iskarta miktari              ";sc%
322 if sc%>df% then print"! Hatali";"■■":goto 320
325 input"      Tamir miktari                ";rw%
327 if sc%+rw%<>df% then print"! Hatali";"■■":goto 325
330 print"      Hata kodu ve miktari"   : print
380 a=10: b=15 : dm=0 : tc%=0 : tc=0
382 kl=kl%(j,l,k)
385 for ll=1 to nh(j,kl)
390 print tab(a) kd$(kl,ll) tab(16)dq%(ll)
392 print"■";tab(b);:input dq%(ll)
395 dm=dm+dq%(ll)
400 if dm>df% or dq%(ll)>99 goto 425
402 if dq%(ll)=0 goto 405
403 dc(ll)=dq%(ll)*(mm(j,k,ll,cc)+bi(j,k,l))*(1+r(j))
404 tc=tc+dc(ll)   :dc%(ll)=dc(ll)+0.5
405 print "■";"                                          "
410 print "■";
415 next
417 if dm<>df% goto 425
420 tc%=tc+0.5 : goto 430
425 print"! Hatali . Bastan baslayarak duzeltiniz "
426 print"■■";:dm=0 : goto385
430 print:print
435 print"Bu kontrol noktasina ait verileri bastan vermek ";
436 print"ister misiniz(e/h)";
440 input c$ :   if c$<>"e" goto 445
442 print"■";"■""*  DUZELTME  TEKRARI  *": goto 280
445 cr=cr+1
450 record#1,(cr)  :print#1,wn%(j)
455 record#1,(cr),6:print#1,dt$
460 record#1,(cr),13:print#1,wv$
465 record#1,(cr),21:print#1,ty$
470 record#1,(cr),23:print#1,c l$
475 record#1,(cr),25:print#1,pq%
480 record#1,(cr),33:print#1,kq%
485 record#1,(cr),40:print#1,df%
490 record#1,(cr),46:print#1,sc%
495 record#1,(cr),52:print#1,rw%
496 p=58 : t=1
500 for kk=1 to nh(j,kl)
502 record#1,(cr),(p):print#1,dq%(kk)
503 record#2,(cr),(t):print#2,dc%(kk)
504 p=p+5 : t=t+8
505 next kk
510 for ll=1 to nh(j,kl): dq%(ll)=0 : dc%(ll)=0 : next ll
512 record#1,(cr),158:print#1,tc%
515 next k
520 next l
522 print"■■■■■■"
525 next i
```

```
ready.

 530 dclose#1
 535 dclose#2
 540 next j
 550 for j=1 to nu
 555 print"■";ug$(j);"  imalati"
 560 fl$=left$(ug$(j),6)+"/iml"   : ff$=left$(ug$(j),6)+"/tl"
 562 i=ng(j)*n(j)
 565 dopen#1,(fl$),d1
 567 dopen#2,(ff$),d1
 570 for l=1 to g(j)
 571 for s=1 to nm(j)
 572 for t=1 to nk(j,s)
 575 i=i+1
 580 record#1,(i)    :input#1,hf%
 585 record#1,(i),6  :input#1,ta$
 590 record#1,(i),13:input#1,aw$
 595 record#1,(i),21:input#1,at$
 600 record#1,(i),23:input#1,ar$
 605 record#1,(i),25:input#1,ur%
 610 record#1,(i),33:input#1,ke%
 615 record#1,(i),40:input#1,ht%
 620 record#1,(i),46:input#1,is%
 625 record#1,(i),52:input#1,dz%
 630 p=58   : q=1
 632 tk=kl%(j,s,t)
 635 for k=1 to nh(j,tk)
 640 record#1,(i),(p):input#1,hm%(k)
 642 record#2,(i),(q):input#2,tl%(k)
 645 p=p+5 : q=q+8
 650 next k
 652 record#1,(i),158:input#1,tm%
 655 print hf% tab(3) ta$ tab(12) aw$ tab(18) at$ tab(20) ar$ ;
 656 print tab(22) ur% tab(29) ke% tab(35) ht% tab(40) is% ;
 660 print tab(45) dz% tab(53) hm%(1) tab(58) tl%(1)
 665 for ir=2 to nh(j,tk)
 670 print tab(53) hm%(ir) tab(58) tl%(ir)
 675 next ir
 680 for k=1 to nh(j,tk): hm%(k)=0 : tl%(k)=0   :next k
 681 print"■";tab(68) tm%
 682 next t
 684 next s
 685 next l
 690 dclose#1
 692 dclose#2
 695 next j
```

```
eady.

699 rem ******   update tanim/iml      ***************************
700 dopen#2,"@tanim",d1,w
701 print#2,wi%
702 print#2,nu
704 for i=1 to nu
705 ng(i)=ng(i)+g(i)
706 print#2,ug$(i) : print#2,ng(i): print#2,wm%(i)
708 next i
710 for i=1 to nu
712 print#2,nm(i)
714 for j=1 to nm(i)
716 print#2,mg$(i,j)
720 print#2,nk(i,j)
722 for k=1 to nk(i,j)
724 print#2,kn$(i,j,k)   : print#2,kl%(i,j,k)
726 next k,j
728 next i
730 dc lose#2
750 print"■"
751 print"   Son kontrol raporlarini islemek istiyor musunuz ( e/h )";
760 input c$
780 if c$="e" goto 2000
899 end
900 print"■"tab(10);
901 print"■""Yeni veri disketinde TANIM/IML dosyasinin hazirlanmasi"
905 dopen#1,"tanim",d1,w
906 input"Yeni disketteki ilk hafta no.";wi% :print#1,wi%
910 input"Urun grubu adedi";nu
915 print#1,nu
917 dim mg$(nu,10),kn$(nu,10,4),kl%(nu,10,4),nm(nu),nk(nu,10)
920 print"Urun grubu adi  ";
925 for i=1 to nu
930 print tab(17);: input ug$(i)
935 print#1,ug$(i)
940 ng(i)=0 : print#1,ng(i) : wm%(i)=0 : print#1,wm%(i)
945 next
950 for i=1 to nu
952 print"■"
955 print ug$(i);"  icin  makina grubu/vardiya  sayisi    ";
956 input nm(i)
960 print#1,nm(i)  : print
962 for j=1 to nm(i)
965 print"   ";j;" . Makina grubu/vardiya kodu                    ";
970 print tab(51);: input mg$(i,j) : print#1,mg$(i,j)
972 input"         Bu makinadaki  kontrol noktasi sayisi     ";nk(i,j)
974 if nk(i,j)>4 then print"■■"  : goto972
975 print#1,nk(i,j) :print
976 if nk(i,j)<4 goto 982
```

```
977 print#1,"Stem Kontrolu" : print#1,1
978 print#1,"Mont Kontrolu" : print#1,2
979 print#1,"Sealex Kontrolu": print#1,3
980 print#1,"Ikmal Kontrolu" : print#1,4
981 goto 997
982 print"     1: stem   / 2: mont  / 3: sealex  / 4: ikmal"
983 for k=1 to nk(i,j)
984 print"          ";k;" . Kontrol noktasi hangi islemden sonra "
985 print "";tab(51);:input kl%(i,j,k)
986 if kl%(i,j,k)<= kl%(i,j,k-1) goto 988
987 on kl%(i,j,k) goto 990,992,993,994
988 print"  ! Hatali","" : goto 984
990 kn$(i,j,k)="Stem Kontrolu": goto 995
992 kn$(i,j,k)="Mont Kontrolu": goto 995
993 kn$(i,j,k)="Sealex Kontrolu" : goto 995
994 kn$(i,j,k)="Ikmal Kontrolu" : goto 995
995 print#1,kn$(i,j,k) : print#1,kl%(i,j,k)
996 next k
997 print"            ": next j
998 next i
999 dclose#1
1000 rem ******   veri dosyalarinin hazirlanmasi   ******************
1010 for i=1 to nu
1020 fl$=left$(ug$(i),3)+"/iml"
1050 dopen#1,(fl$),d1,l167
1100 record#1,20
1150 print#1,chr$(255)
1160 dclose#1
1200 ff$=left$(ug$(i),3)+"/tl"
1210 dopen#1,(ff$),d1,l160
1220 record#1,20
1230 print#1,chr$(255)
1250 dclose#1
1270 next
1300 clr: goto 162
1400 rem ************ hata listeleri ********************************
1420 for i=1 to nu
1425 for k=1 to 4
1435 fl$=left$(ug$(i),3)+"/"+str$(k)+"/hata"
1437 jj=0 : dm=0
1440 dopen#2,(fl$),d0
1450 jj=jj+1
1455 input#2,kd$(k,jj) : input#2,lg
1465 if kd$(k,jj)<>"000" goto 1450
1470 dclose#2
1475 nh(i,k)=jj
1480 next k
1485 next i
1490 return
```

```
ready.

 1500 rem ************ maliyetler      ********************************
 1510 dim mm(nu,4,20,7),bi(nu,4,4)
 1520 for i=1 to nu
 1525 for k=1 to 4
 1530 ff$=left$(ug$(i),3)+"/"+str$(k)+"/mtl"
 1540 dopen#1,(ff$),d0
 1545 for j=1 to nh(i,k)
 1550 for l=1 to 7
 1555 input#1,mm(i,k,j,l)
 1560 next l,j
 1565 dclose#1
 1570 next k,i
 1575 for i=1 to nu
 1580 ff$=left$(ug$(i),3)+"/isci"
 1585 dopen#1,(ff$),d0
 1590 for k=1 to 4
 1595 for j=1 to nm(i)
 1600 input#1,bi(i,k,j)
 1605 next j,k
 1610 dclose#1
 1620 next i
 1630 dopen#1,"ime",d0
 1635 for i=1 to nu
 1640 input#1,r(i)
 1645 next
 1649 dclose#1
 1650 return
 1660 rem ******************   arizali  ********************************
 1665 ty$="-" :cl$="-" :pq%=0 : kq%=0 : df%=0 : sc%=0 : rw%=0 :tc%=0
 1670 for ll=1 to nh(j,k) : dq%(ll)=0 : dc%(ll)=0 : next ll
 1675 cc=0  : return
 1680 rem *************  ampul cinsi ********************************
 1681 ac$=left$(wv$,3)
 1682 if ac$=" "+"15" then cc=1 :return
 1684 if ac$=" "+"25"then cc=2 : return
 1686 if ac$=" "+"40" then cc=3:  return
 1688 if ac$=" "+"60" then cc=4 : return
 1690 if ac$=" "+"75" then cc=5 : return
 1692 if ac$="100" then cc=6 :return
 1694 cc=7 :return
```

```
ready.

 1700 rem ***  son iskartalari hata dosyasinda arar *********
 1710 f4$=left$(ug$(j),6)+"/hata" :err=0
 1715 dopen#4,(f4$),d0
 1720 xx=1 : zz=51
 1725 vv=int((xx+zz)/2)
 1735 record#4,(vv):input#4,kd$
 1740 if kd$=ko$  or xx>zz goto 1760
 1745 if kd$>ko$  goto 1755
 1750 xx=vv+1 : goto 1725
 1755 zz=vv-1 : goto 1725
 1760 if xx>zz then err=1 : return
 1765 record#4,(vv),31:input#4,sl$
 1770 dclose#4
 1790 return
 2000 rem ****      son kontrol verileri     ***************************
 2005 dopen#1,"tanim/son",d1
 2010 for i=1 to nu
 2015 input#1,ng(i):input#1,wn%(i)
 2020 next i
 2025 dclose#1
 2030 for i=1 to nu
 2032 for k=1 to 4
 2034 for j=1 to 7
 2040 mm(i,k,0,j)=(mm(i,4,19,j)+bi(i,4,k))*(1+r(i))
 2042 next j
 2044 next k
 2046 next i
 2048 dim dc$(15),lg$(15)
 2049 dim kg$(15),og$(15),gn$(15),gt%(15)
 2050 for j=1 to nu
 2052 print"■■■■■■":printtab(25)"■"ug$(j);" son kontrolleri■"
 2054 printtab(20);:input"Kac gunluk veri eklenecek ";g(j)
 2056 if g(j)=0 goto 2200
 2058 cr=ng(j)*nm(j)*2
 2060 fl$=left$(ug$(j),6)+"/son"
 2062 f1$=left$(ug$(j),3)+"/glow" : f2$=left$(ug$(j),3)+"/isik"
 2064 dopen#1,(fl$),d1
 2065 dopen#1,(f1$),d1
 2066 dopen#1,(f2$),d1
 2068 for i=1 to g(j)
 2070 printtab(20);:input"Hafta no.                    ";w%
 2072 if w%>=wn%(j) then wn%(j)=w% : goto 2080
 2074 print"! Hatali","■■" : goto 2070
 2080 printtab(20);:input"Tarih    ( GG,AA,YY )       ";t1$,t2$,t3$
 2085 dt$=t3$+t2$+t1$ : ta$=t1$+"/"+t2$+"/"+t3$
 2090 if len(dt$)=6 and t1$<="31" and t2$<="12" goto2100
 2095 print"! Hatali";"■■" : goto 2080
 2100 for l=1 to nm(j)
```

```
2105 print"■":print"     "
2110 print"TARIH : ";ta$tab(23) "URUN GRUBU : ";ug$(j) tab(51);
2112 print"MAK.GRUBU/VARDIYA : ";mg$(j,1) : print
2115 print tab(28)"SON KONTROL "; :print
2118 for ln=1 to 79 : print"-"; :next :print
2120 input"      Ampul cinsi ( Watt/Volt )";wv$
2121 if wv$="arizali" then  gosub 1660 :goto 445
2122 wv$=right$(" "+wv$,7)
2123 if mid$(wv$,4,1)<>"/"then print"!Hatali""■■":goto2120
2124 gosub 1680
2125 input"      Ampul tip kodu             ";ty$
2127 if len(ty$)<>1 then print"! Hatali";"■■":goto 2125
2130 input"      Ampul renk kodu            ";cl$
2132 if len(cl$)<>1 then print"! Hatali";"■■":goto 2130
2135 input"      Uretim miktari             ";pq%
2140 input"      Numune adedi               ";kq%
2142 if kq%>pq% or kq%>9999  then print"! Hatali";"■■":goto 2140
2145 input"      Toplam glow iskartasi      ";gd%
2147 if gd%>kq% or gd%>999   then print"! Hatali";"■■":goto 2145
2150 print"     ■ Glow iskartalari ■  " : jj=0   : dm=0 :tc%=0
2152 print"      (kod,miktar) seklinde veriniz,sonuncudan sonra (0,0)"
2153 print" yaziniz"
2154 jj=jj+1 : kk=kk+1
2155 print"      ":input dc$(jj),dq%(jj)
2156 if dc$(jj)="0" goto 2185
2157 ko$=dc$(jj) : gosub 1700
2158 if err then print "! Hatali";"■■" :goto 2155
2159 lg$(jj)=sl$
2160 dm=dm+dq%(jj) :if dm<=gd% goto 2170
2165 print"! Hatali";
2167 for ll=1 to kk+4 : print"■";:next :print :goto 2150
2170 dc%(jj)=dq%(jj)*mm(j,0,0,cc)+0.5
2172 tc%=tc%+dc%(jj)
2174 if kk<10 goto 2180
2176 for s=1 to kk+1 : print"■"; : next :print : kk=0
2180 goto 2154
2185 if dm<gd% goto 2165
2187 jj=jj-1
2190 for ll=1 to kk+4 : print"■";:next :print
2200 input"      Toplam isik iskartasi      ";id%
2202 if id%>kq% or id%>999   then print"! Hatali";"■■":goto 2200
2205 input"      Kontrol edilecek miktar    ";rq%
2210 print"     ■ Isik iskartalari ■  " : tt=0   : dm=0 :ti%=0
2212 print"      (kod,miktar) seklinde veriniz,sonuncudan sonra (0,0)
2213 print" yaziniz"
2214 tt=tt+1 : kk=kk+1
2215 print"      ":input ic$(tt),iq%(tt)
2216 if ic$(tt)="0" goto 2245
2217 ko$=ic$(jj) : gosub 1700
2218 if err then print "! Hatali";"■■" :goto 2215
```

```
2219 ig$(jj)=sl$
2220 dm=dm+iq%(tt) :if dm<=id% goto 2230
2225 print"! Hatali";
2227 for ll=1 to kk+4 : print"■";:next :print : goto 2210
2230 ic%(tt)=iq%(tt)*mm(j,0,0,cc) +0.5
2232 ti%=ti%+ic%(tt)
2234 if kk<10 goto 2140
2236 for s=1 to kk+1 : print"■"; : next :print : kk=0
2240 goto 2214
2245 if dm<id% goto 2225
2250 tt=tt-1
2255 for ll=1 to kk+4 : print"■";:next :print
2260 input"      Son iskarta miktari       ";bc%
2265 bm%=bc%*mm(j,0,0,cc)+0.5
2275 print"Bu makinaya ait verileri bastan vermek ister misiniz ";
2276 print"( e/h ) "; : input c$
2280 if c$="e" then print"■";"■ *  DUZELTME  TEKRARI  * ": goto 2110
2300 cr=cr+1
2305 record#1,(cr)    :print#1,wn%(j)
2310 record#1,(cr),6  :print#1,dt$
2315 record#1,(cr),13:print#1,wv$
2320 record#1,(cr),21:print#1,ty$
2325 record#1,(cr),23:print#1,cl$
2330 record#1,(cr),25:print#1,pq%
2335 record#1,(cr),33:print#1,kq%
2340 record#1,(cr),40:print#1,gd%
2345 record#1,(cr),45:print#1,tc%
2350 record#1,(cr),55:print#1,id%
2355 record#1,(cr),60:print#1,rq%
2360 record#1,(cr),68:print#1,ti%
2365 record#1,(cr),78:print#1,bc%
2370 record#1,(cr),85:print#1,bm%
2375 p=1
2380 for ll=1 to jj
2385 record#2,(cr),(p):print#2,dc$(ll)
2390 record#2,(cr),(p+4):print#2,lg$(ll)
2395 record#2,(cr),(p+6):print#2,dq%(ll)
2400 record#2,(cr),(p+11):print#2,dc%(ll)
2405 p=p+19
2410 next ll
2412 record#2,(cr),(p):print#2,"000"
2415 p=1
2420 for ll=1 to tt
2425 record#3,(cr),(p):print#3,ic$(ll)
2430 record#3,(cr),(p+4):print#3,ig$(ll)
2435 record#3,(cr),(p+6):print#3,iq%(ll)
2440 record#3,(cr),(p+11):print#3,ic%(ll)
2445 p=p+19
2450 next ll
2455 record#3,(cr),(p):print#3,"000"
2460 next l
```

```
2465 print"■■■■■■"
2470 next i
2472 dclose#1
2474 dclose#2
2476 dclose#3
2480 next j
2500 for j=1 to nu
2505 print"■",ug$(j);" son kontrolu"
2510 f1$=left$(ug$(j),6)+"/son"   : i=ng(j)*nm(j)*2
2515 f1$=left$(ug$(j),3)+"/glow" : f2$=left$(ug$(j),3)+"/isik"
2520 dopen#1,(f1$),d1
2522 dopen#2,(f1$),d1
2524 dopen#3,(f2$),d2
2530 for l=1 to g(j)
2535 for s=1 to nm(j)
2540 i=i+1
2545 record#1,(i)    :input#1,hf%
2550 record#1,(i),6  :input#1,ta$
2555 record#1,(i),13:input#1,aw$
2560 record#1,(i),21:input#1,at$
2565 record#1,(i),23:input#1,ar$
2570 record#1,(i),25:input#1,ur%
2575 record#1,(i),33:input#1,ke%
2580 record#1,(i),40:input#1,gl%
2585 record#1,(i),45:input#1,gm%
2590 record#1,(i),55:input#1,is%
2595 record#1,(i),60:input#1,yk%
2600 record#1,(i),68:input#1,im%
2605 record#1,(i),78:input#1,si%
2610 record#1,(i),85:input#1,sm%
2615 p=1 : ll=0
2620 ll=ll+1
2625 record#2,(i),(p):input#2,kg$(ll)
2630 if kg$="000" goto 2650
2635 record#2,(i),(p+4):input#2,og$(ll)
2640 record#2,(i),(p+6):input#2,gn%(ll)
2645 record#2,(i),(p+11):input#2,gt%(ll)
2647 p=p+19 : goto 2620
2650 p=1 : jj=0
2655 jj=jj+1
2660 record#3,(i),(p):input#3,ki$(jj)
2665 record#3,(i),(p+4):input#3,oi$(jj)
2670 record#3,(i),(p+6):input#3,ia%(jj)
2675 record#3,(i),(p+11):input#3,it%(jj)
2680 p=p+19 : goto 2655
2682 if ki$(jj)="000" goto 2685
2685 print hf%tab(3)ta$tab(11)aw$tab(18)at$;ar$tab(22) ur% ;
2686 print tab(29) ke% tab(35);
2687 print gl%tab(40)gm%tab(50)is%tab(56)yk%tab(65)im%tab(74)si%
```

```
2690 for kk=1 to ll-1
2695 print kg$(kk),og$(kk),gn%(kk),gt%(kk)
2700 next kk
2705 for kk=1 to jj-1
2710 print ki$(kk),oi$(kk),is%(kk),it%(kk)
2715 next kk
2720 next s
2725 next l
2730 dclose#1
2735 dclose#2
2740 dclose#3
2745 next j
2750 dopen#1,"@tanim/son",d1,w
2755 for i=1 to nu
2760 ng(i)=ng(i)+g(i):print#1,ng(i):print#1,wn%(i)
2765 next i
2770 dclose#1
2790 end
```

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